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MANAGEMENT OF FRACTURES OF LOWER JAW IN CHILDREN

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METHODS OF FIXATION AND DIFFICULTIES ENCOUNTERED

From time to time various methods have been suggested and used for immobilization of fracture fragments in children. In the use of these methods, various difficulties have been encountered. A list of some of these methods of fixation and their concomitant difficulties follows:

1. *Tight bandages.* Bandages can be used as temporary measures, but they are not good for permanent fixation.
2. *Intramaxillary wiring.* This method is not suitable in children, for (a) wires are likely to slip because of the shape and loose contact points of the deciduous teeth, (b) incomplete roots of permanent teeth and partially resorbed roots of the deciduous teeth are too weak and unsuitable for wiring, and (c) it is both difficult and undesirable for children to keep their mouths closed for long periods. A method which allows the child to open his mouth is much more desirable.
3. *Direct wiring or plating of the fractured ends.* This method is a complicated one and may be risky at times. Moreover, the permanent tooth buds may be injured.
4. *Splints.* Various types of splints have been designed and recommended, but it is difficult to retain them with cement only. Children are likely to fidget with the splints and displace them.
5. *Extraoral fixation.* These methods are not favored because (a) at times they are difficult to manipulate, (b) they do not give perfect

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immobilization for the entire period of treatment, and (c) it is embarrassing for the patients to go about with extraoral appliances on their faces.

6. *Cast-metal splints with circumferential wiring.* We have been trying this method in our hospital, and the results have been so consistently good that we are reporting the technique in detail in this article.

TABLE I. RESULTS OBTAINED WITH METAL SPLINTS AND CIRCUMFERENTIAL WIRING

CASE NO.	AGE	FRACTURE SITE	RESULTS
1	6½	Between $\overline{\lvert C}$ and $\overline{\lvert D}$	Excellent
2	7	Between $\overline{2\rvert}$ and $\overline{C\rvert}$	Excellent
3	10	Between $\overline{1\rvert}$ and $\overline{2\rvert}$	Excellent
4	8	Between $\overline{1\rvert}$ and $\overline{\lvert 1}$	Excellent
5	7	Between $\overline{C\rvert}$ and $\overline{D\rvert}$	Excellent
6	7½	Between $\overline{\lvert 1}$ and $\overline{\lvert 2}$	Excellent
7	8	Double fracture, $\overline{C\rvert}$ area and $\overline{\lvert 7}$ area	Slight anterior open-bite

Note: Case 7 was treated with splint and circumferential wiring for the $\overline{C\rvert}$ area and direct wiring of the fragments for the fracture in the angle of the mandible on the opposite side.

TECHNIQUE

Impression Taking.—Because of lack of cooperation on the part of children, we routinely take the impressions with Zelex after the patient is fully relaxed under general anesthesia. Premedication, if used, consists of $\frac{1}{200}$ gr. atropine one-half hour before anesthesia is induced. Ethyl chloride is used for the induction of anesthesia, after which ether is given by the semiclosed method with the help of an endotracheal tube passed through the nose. The throat is packed to avoid aspiration of blood, secretions, and debris. The impression, taken in the usual way, is quite easy to obtain and no difficulty has been experienced so far. Suitable trays are selected and the impressions of the upper and lower jaws are taken. The lower impression may be taken in section if the displacement is great. The anesthesia is discontinued and the patient is sent to the recovery room. The patient may be allowed to go home four hours after regaining consciousness.

From the impressions, models are made in hard-stone plaster. The lower cast is sawed into parts along the lines of fracture (if the impression has been taken in one piece). The teeth of these pieces are then carefully occluded with those of the upper model. The pieces of lower cast are then united by the addition of a little soft plaster while they are in occlusion with the upper model. This reconstructed model represents the jaw as it was prior to the accident. The models are then articulated.

Wax Pattern.—A splint pattern is made in casting wax over the reconstructed lower model. Care should be taken that (1) the wax over the occlusal surface is kept thin (two thicknesses of Ash casting wax No. 8 are sufficient)

and (2) the pattern is made slightly thicker at the periphery so as to impart strength (this is done by rounding the periphery with added wax slightly beyond the gingival margin).

Cast Splint.—The pattern is cast in silver hardened with copper. It has been our experience that old silver coins bearing the impressions of Victoria, George V, or Edward VII, which are no longer legal tender, come in very handy. This alloy serves the purpose very well.

Reduction and Fixation.—After general anesthesia has been administered once again as described earlier, the patient is made ready for the reduction and fixation. The skin of the face, especially the submandibular region, is prepared in the usual manner with alcohol. The lips are coated with petrolatum. The mouth is cleaned with gauze, after which a weak iodine solution is applied. The splint is then tried in the mouth.

It is possible that some callus formation may have caused partial union. After a small incision has been made, this callus formation is easily broken with the help of osteotome or any other suitable instrument. (Care must be taken that no tooth crypt is injured.) Bleeding is controlled with pressure. The fracture is then easily reduced and the splint applied over the teeth. The incised soft tissue may be sutured.

Passing of Wire.—Circumferential wiring is done on either side of the fracture line. In order to get balanced force, the wires should be passed midway between the end of the splint and the fractured area on either side. A 21 gauge hypodermic needle is bent so that it will follow the curvature of the bone. It is inserted through the skin at the lower border of the mandible until the tip passes through the floor of the mouth along the inner surface of the jaw. A 36 gauge stainless steel wire is then inserted through the needle and passed upward. The end of the wire is held with an artery forceps and the needle is withdrawn. The needle is then inserted from the labial or buccal aspect of the jaw from the inside of the mouth until it pierces the skin at a point as close as possible to the previous puncture. The end of the wire, extending from the skin, is passed into the point of the needle and pushed up until it emerges from the hub. Then the needle is withdrawn.

Tissues between the two wire punctures are incised right up to the bone with a thin, sharp knife. Both of the wire ends inside the mouth are stretched so that the wire is well adapted to the mandible. Care is taken that no bend or twist is left in the tissues. The skin wound may be sutured if so desired. After both wires are inserted, they are held with artery forceps while the splint is cemented into position. Then the two ends of the wires are twisted over the metal splint and tightened. The loose ends of each loop are snipped off and bent in such a way as not to injure the soft tissues. Stainless steel wires are well tolerated and may be retained for several weeks.

Postoperative Care.—While the patient is recovering from anesthesia, he should be prevented from disturbing the splint and measures should be taken so that the patient will not roll onto the injured side. Accumulations of blood and saliva in the mouth should be aspirated as and when necessary. Antibiotic therapy may be instituted if indicated.

Fig. 1.

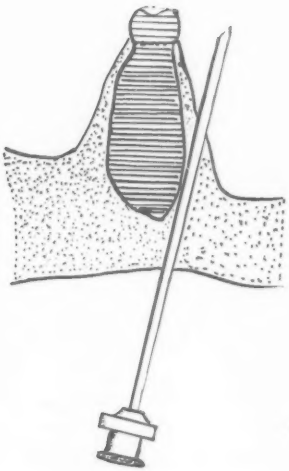
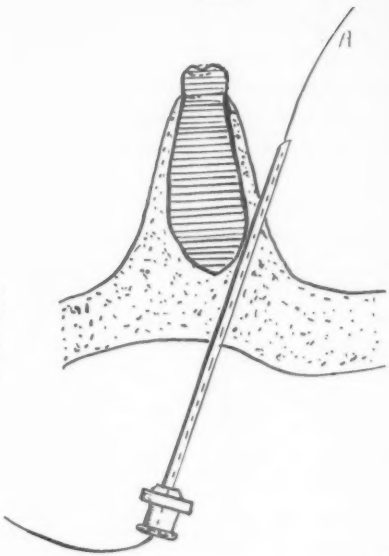


Fig. 2.



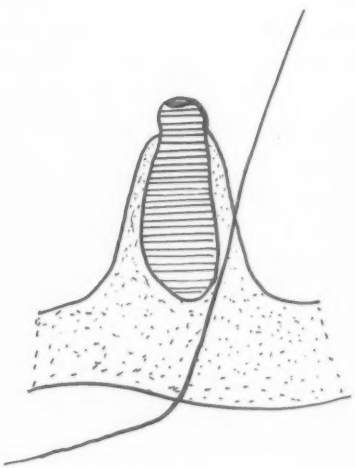


Fig. 3.

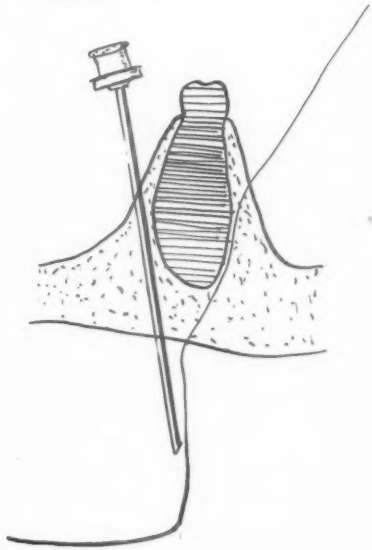


Fig. 4.

Fig. 1.—The needle is inserted on the lingual side.

Fig. 2.—Stainless steel wire is passed and held at *A* with an artery forceps.

Fig. 3.—The needle is withdrawn.

Fig. 4.—The needle is inserted from the buccal aspect and the point emerges from the skin very near the first puncture. This can be done easily, as the soft tissues are loose and may be shifted over the bone.

On the second day all wounds, whether sutured or not, are inspected. The position of the splint should be checked roentgenographically. Cheeks and lips should be examined to see if the wires are causing any injury or have become loose. Necessary adjustments should be made.

Fig. 5.

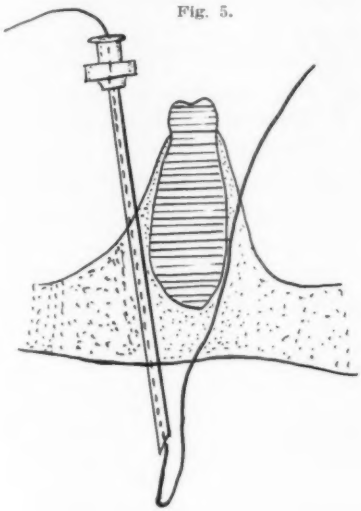
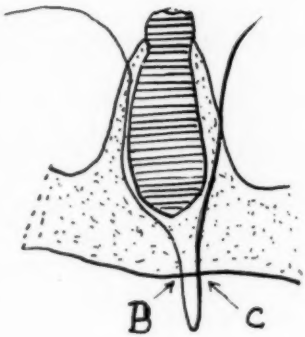


Fig. 6.



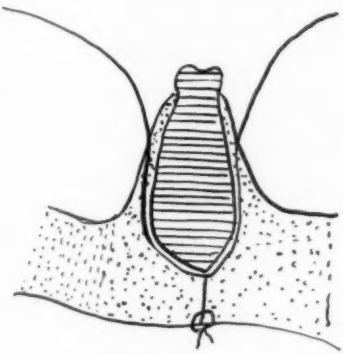


Fig. 7.

Fig. 5.—The free end of wire outside the mouth is inserted into the needle point to emerge from the hub.

Fig. 6.—The needle is withdrawn. The skin between *B* and *C* is incised, and the incision is carried on deep to the bone.

Fig. 7.—Wire is stretched around the body of the mandible. The outer wound is sutured.

Oral Hygiene.—This is very important. A mouth-wash should be prescribed and used frequently. Saline solution sweetened with saccharine is generally adequate and not much resented by the patient. Bed rest for at least five days should be prescribed in all but the simplest cases. Diet should be in the form

of liquid food for the first week only. Later, soft foods may be given. Hard food is to be avoided until two weeks after the splint has been removed.

Duration of Fixation.—The healing of the fracture is directly related to the health of the patient. The circumferential wires and splint are left in place until the fracture has healed, which may take up to six weeks in ordinary cases.

Splint Removal.—First, the twisted end of the wires is snipped off. Then, by getting hold of one end, the operator can withdraw the wires with a quick pull. After this the splint can be removed. The procedure is practically painless for the patient. An antiseptic may be applied at points where the wires had entered tissues. The occlusion is then checked. The mouth is thoroughly rinsed, and prophylaxis is given later on. Check-up roentgenograms are taken before the patient is discharged.

ADVANTAGES OF THE METHOD

We find that the method just described is very good for the following reasons:

1. Good occlusion results after this treatment.
2. It is easy to manipulate.
3. The child can open his mouth throughout the fixation period, and we find that most of the patients can take soft food six or seven days after fixation.
4. A child can be permitted to go to school one week after fixation.
5. Cumbersome extraoral fixation appliances and the operation of opening up the fragments are avoided.
6. No disfigurement is left after treatment.

(*Note:* We cannot recommend this method if there is an additional fracture in the ramus, as that is likely to leave an anterior open-bite. In such cases the mouth has to be kept closed in occlusion.)

ANASTOMOSIS OF A SEVERED PAROTID DUCT

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THE following case is reported to demonstrate the use of polyethylene tubing as a splint in the repair of a severed parotid duct.

CASE REPORT

Complaint and History of Illness.—On the evening of Aug. 22, 1955, a 45-year-old man was brought to the receiving ward at Pennsylvania Hospital with a laceration of the face. The patient was fully conscious and in no acute distress, but he was moderately inebriated. There was no history of unconsciousness or of other body injuries. The medical intern on duty examined and treated the patient shortly after his arrival. He cleansed the wound and closed it with several cotton sutures. Approximately one hour later, when the patient was to be discharged, he developed a painful swelling of the face. The intern requested an oral surgery consultation.

Examination.—A vertical laceration, midway between the commissure of the lip and the left ear, had been closed tightly with several interrupted cotton sutures. There was no bleeding or drainage from the wound. The swelling, which had developed suddenly after closure, appeared to be more pronounced posterior to the laceration. It was firm and very tender to touch. There was no evidence of facial paralysis from injury to branches of the facial nerve. Intraorally, the left buccal mucosa was intact. The remaining tissues and structures of the oral cavity were normal. There was no salivary flow from the orifice of the parotid duct when the gland was massaged. A probe was placed into the duct, but an obstruction was encountered in the area of the laceration.

On the basis of the clinical findings, the diagnosis was established as salivary retention secondary to severance of the parotid duct. The diagnosis was confirmed by taking the patient to the oral surgery clinic, where a sialogram was made after injection of a contrast medium (Iodochlorol) into the duct. The x-ray picture showed filling of the duct to a point coinciding with the area of laceration. There was no material in the proximal portion of the duct or in the gland.

Treatment.—The patient was returned to the receiving ward, where a physical examination, blood count, and urinalysis were performed. No abnormalities were found. The patient was prepared for surgery that same night. He was given morphine, $\frac{1}{6}$ gr., and scopolamine, $\frac{1}{150}$ gr., and thirty minutes later he was sent to the operating room.

Operation.—A local anesthetic was administered, and the patient was prepared and draped in the usual manner for an extraoral procedure. The cotton sutures were removed. The wound was examined for bleeders, but complete hemostasis had been established when the intern closed the laceration in the receiving ward.

A steel probe was passed from the mouth through the distal segment of the left parotid duct and into the wound. A piece of fine polyethylene tubing was pushed onto the end of the probe protruding from the laceration. The probe was withdrawn, pulling the tubing back into the mouth. The proximal end of the duct (the end attached to the gland) was

located in the wound. A piece of No. 22 stainless steel wire was passed through this portion of the duct and through the substance of the gland. Pressure was applied to the wire until it pierced the posterior capsule of the gland. The end of the wire could be palpated

Fig. 1.—Photograph showing the wound three days postoperatively. Note the distal end of the tubing protruding below the ear.

Fig. 2.—The tubing sutured to the buccal mucosa.

subcutaneously behind the lobe of the left ear. A small skin incision was made at this point, and the wire was pulled through. A piece of black silk was tied to the wire and pulled back through the gland and proximal duct into the wound. The end of the plastic tubing was perforated with a needle, and the string was attached. The tube was pulled

Fig. 3.—The patient two months postoperatively.

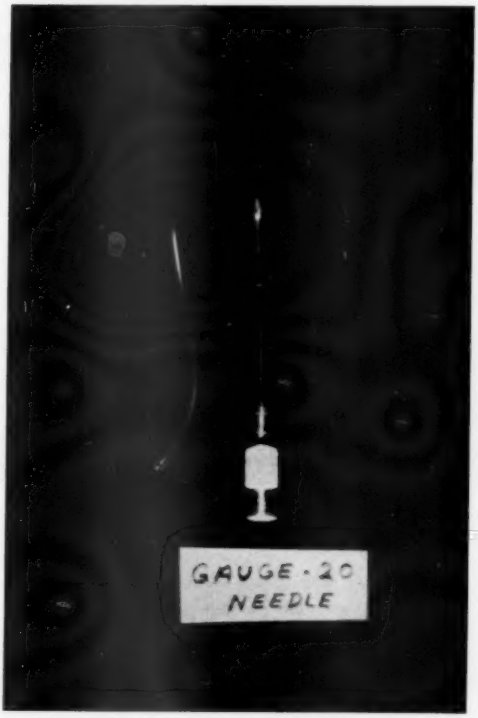

Fig. 4.—Sample of the polyethylene tubing.

by the string through the proximal duct and the gland and out through the skin incision below the ear. Thus, the tubing passed through the entire duct and gland, with one end on the skin surface below the left ear and the other end protruding into the mouth. With the tube serving as a splint, the severed ends of the duct were approximated. Six interrupted sutures were placed at intervals around the wall of the duct with 00000 black

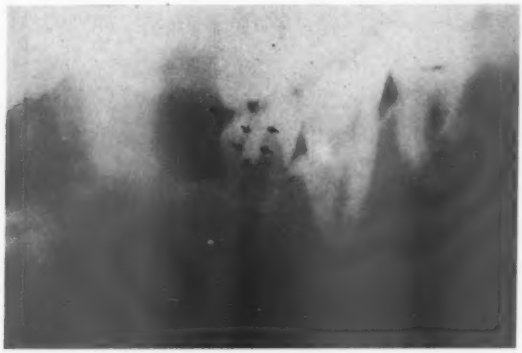

Fig. 5.—Sialogram demonstrating incomplete filling of the parotid duct preoperatively.

Fig. 6.—Sialogram two months postoperatively, showing patency of the parotid duct. (The grid pattern of the print was caused by the photographer's technique for improving the contrast of an underexposed x-ray film.)

silk on an atraumatic needle. The wound was closed in layers, with 000 plain catgut used for the deep tissues and 00000 Dermalon for the skin. The posterior end of the tubing was sutured to the skin, and the small incision was coated with collodion. The anterior end was sutured to the buccal mucosa. A dry, sterile bandage was placed over the operative site.

The patient tolerated the procedure well. He was taken to the receiving ward.

Postoperative Course.—A combination of procaine penicillin, 600,000 units, and dihydrostreptomycin, 1.0 Gm., was given intramuscularly. Also, a dose of 1,500 units of

tetanus antitoxin was administered before the patient was discharged in the custody of the City Police. Banthine (Searle), 50 mg. every six hours, was prescribed to reduce salivary secretion.

On August 23 the patient returned to the oral surgery clinic. The dressing was changed, and the wound was examined. The plastic tubing had not been disturbed. The patient had very little discomfort. Antibiotic therapy was continued, as before.

On August 24 the patient returned for antibiotic therapy. He had no complaints.

The dressing was changed on August 25, and alternate sutures were removed.

On August 27 the remaining sutures were removed. The wound was healing nicely.

The polyethylene tubing was removed on September 1. There was free passage of saliva from the gland through the repaired duct. The skin incision below the left ear was freshened and sutured under local anesthesia. The sutures were removed from below the ear on September 7.

When the patient was seen on October 26, the wound had healed completely with minimum scar formation. There was a normal flow of saliva through the duct. A sialogram showed that the duct had healed without constriction of its lumen. No further treatment was needed, and the patient was discharged.

COMMENT

The narrow-gauge polyethylene tubing proved to be ideal for use as a splint in the foregoing case. There was sufficient space between the outer surface of the tube and the inner surface of the duct to allow saliva to flow freely. It may be advisable in other cases, however, to perforate the tube where it lies within the gland. This would allow saliva to pass into and through the lumen of the tubing, thus assuring an immediate and complete flow when the gland is stimulated. Salivation was reduced in this case with Banthine, an anticholinergic drug.

The tubing was passed through the gland and fastened to the skin in order to prevent the patient from pulling it from his mouth. There was the possibility that he would become inebriated again during the course of healing and attempt to remove the splint. Fortunately, the anchored tube was not disturbed, and healing was uneventful.

107 Long Lane.

A PERSISTENT PAROTID SWELLING

Report of a Case

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LYMPH nodes lie within and near the parotid gland, but in the normal state they are not palpable. An enlarged lymph node, however, can closely resemble a parotid tumor. These nodes drain the parietal and temporal areas and the skin around the eyelids. As one examines these and obtains a noncontributory past history, the probability of the parotid enlargement being explained on such a basis lessens and the chances of the mass being a primary parotid tumor become increasingly stronger.[1]

Infections of and about the parotid gland can be distinguished from tumors by the diffuse involvement, tenderness to palpation, and pain upon mastication of sour substances if primarily intraglandular. The buccal and especially the supramandibular lymph nodes also receive lymph from deeper parts of the face, the mucous membrane of the lips and cheek, and occasionally even from the maxillary and mandibular teeth and the adjacent gingiva.[2] Elimination of the infection with adequate antibiotic and supportive therapy usually relieves all symptoms.[3]

Persistent swelling, changing in one or more characteristics, requires further observation and evaluation.

CASE REPORT

An obese 65-year-old Negro woman in no apparent distress presented with a chief complaint of persistent left parotid area swelling with vague episodic pain.

History of Present Illness.—During the spring of 1957 the patient first noticed a diffuse left preauricular swelling. A routine x-ray examination prior to full denture prosthesis revealed a retained left mandibular cuspid root fragment and cyst about an unerupted first premolar. On Nov. 14, 1957, an excision biopsy of the left body of the mandible was performed. Microscopic description of the tissue was as follows: (1) dental granuloma with cystic areas (keratin cysts) and epithelial hyperplasia, (2) extensive subacute and chronic inflammatory (predominant plasma cellular) and hemorrhagic—necrotic changes, and (3) trunks of nerve fibers and chips of bone.

The lower left lip had been numb since this biopsy procedure, with no apparent change in the size of the swelling, but the tumor was now well circumscribed.

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The patient was admitted to St. Vincent Charity Hospital for a diagnostic work-up. Her past history was noncontributory, and a systems review was essentially normal.

Head and Neck.—The patient was edentulous and had worn dentures comfortably. All oral structures were essentially normal. The left body of the mandible showed the scar of the previous operation, with the lateral (buccal) plate of bone removed. The bone had been obviously smoothed, and saucerization had been effected. There was moderate reddening of the mucosa over this area.

The 1 by ¾ inch mass in the left parotid area was firm, nontender, noncompressible, noninflammatory, and not fixed to the skin. It did not change in size or become enlarged on eating. The mass was not apparently fixed to the mandible or masseter muscle. It displaced the lower ear lobe laterally (Fig. 1).

Fig. 1.—Profile view showing preauricular facial asymmetry with the classic lateral displacement of the lower ear lobe by parotid "tail" involvement.

Laboratory Findings.—Hemoglobin, hematocrit, white blood count, urinalysis, alkaline phosphatase, calcium, and phosphorus were within normal limits. The Wintrobe sedimentation rate was 52 (corrected, 31).

X-ray Findings.—Sialography with Iodochlorol revealed a normal pattern and arborization. The left mandible exhibited a large polycystic radiolucent area. Loss of bone substance may have been the result of the recent operation (Fig. 2). A posteroanterior chest film disclosed no signs of pulmonary or osseous metastasis from the parotid tumor.

Operations.—On April 17, 1958, under adequate Pentothal sodium anesthesia supplemented by endotracheal cyclopropane, nitrous oxide, and oxygen, the head and neck were prepared and draped in an appropriate manner. An intraoral incision was made from the junction of the vertical and horizontal body of the left mandible to the symphysis. The incision was made along the crest of the intact lingual alveolar bone. The buccal and lingual mucosa was reflected to the inferior border of the mandible. Gross observation revealed that the buccal bone was removed. This was consistent with the operation of November, 1957. Further inspection showed that there was no regeneration of the buccal plate of bone and that the body of the mandible consisted, for the most part, of lingual cortical plate. There was little cancellous or medullary bone in evidence. In the molar area, the contents of what appeared to be the inferior alveolar nerve canal were visualized and a biopsy specimen of

the canal contents was taken. Similarly, bone was removed from around the canal. A second biopsy specimen was taken from the intact lingual cortical plate in the mental area. A third specimen was taken from the juncture of the vertical and horizontal ramus. The contents of the inferior alveolar nerve canal were examined, and this canal was followed to where it disappeared in its upward and inward course within the ascending ramus. All areas of biopsy were smoothed. The buccal and lingual tissue was reapproximated with 00000 Dermalon interrupted sutures.

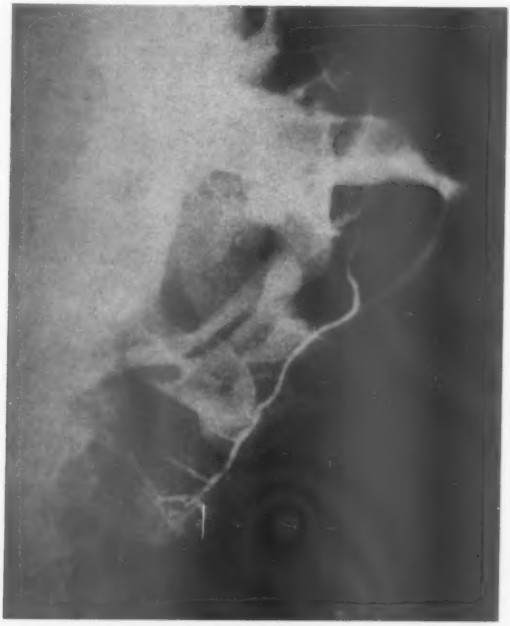

Fig. 2.—Lateral view of the body of the left mandible showing the extent of the previous lesion, with no x-ray evidence of bone regeneration. Sialogram shows normal arborization.

On April 22, 1958, following induction of endotracheal general anesthesia, the left parotid area was prepared and draped in the usual manner. A Y type of incision was made below the left ear, with one limb extending up anterior to the left ear and the other up slightly posterior to the left ear with an extension downward beneath the angle of the mandible. Skin flaps were dissected back and caught and ligated with interrupted 000 plain catgut. Dissection was then begun at the lower pole of the parotid gland. By blunt and sharp dissection, the cystic mass was freed up at the lower portion of the parotid gland. The mass was found wound around the inferior and posterior aspects of the mandibular angle. The greater portion lay on the medial aspect of the vertical ramus. After most of the mass was freed, it was inadvertently ruptured. The region medial to the ramus, lateral to the inferior pterygoid muscle, and superior to the posterior belly of the digastric muscle was completely freed of tumor. A Penrose drain was placed in the depths of the wounds, and the tissues were approximated by 000 plain catgut. A dry sterile dressing was placed after the skin was closed with 0000 black silk sutures.

Pathologic Reports.—

Biopsy of the mandible revealed (1) chronic ulcer of mucous membrane with foreign body reaction, (2) focal myelofibrosis of lingual bone, and (3) nerve tissue with interstitial fibrosis.

Fig. 3.

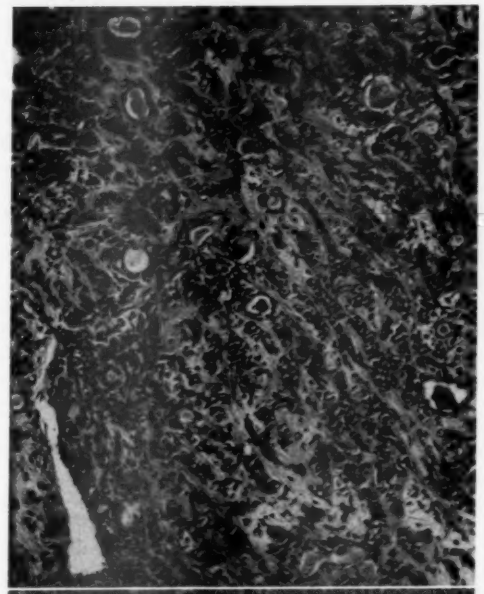

Fig. 4.

Figs. 3 and 4.—Medium-power photomicrographs of sections of the tumor showing the admixture of cells and tissue substance and complete absence of normal parotid tissue pattern.

Microscopic description of the excised mass: One section showed scanty amounts of parotid tissue infiltrated by fat, seen at the margin of the section. Conspicuous numbers of round cells infiltrated the stroma of the glandular tissue. Adjacent to the gland was a thick connective tissue capsule which was somewhat fibrotic and rather poorly vascularized. Separated from the capsule by a clear space was a mass of focally hemorrhagic and necrotic tumor. It varied in density from area to area. It consisted of loosely arranged small, oval, ductlike structures lined by poorly defined small cuboidal cells with prominent nuclei. Many contained pink amorphous material. There was no evidence of epithelial anaplasia. The stroma varied in amount and density. Generally it was dense and pale pink with intermingled small irregular foci, which were pale staining and suggested a mucoid appearance. Occasional epithelial cells which were loosely arranged and in small cords were seen in the more abundant stroma, and in some areas large, pale vesicular nuclei with prominent nucleoli were noted along with elongated spindle and plump fibroblastic cells (Fig. 3). Focally, the cells appeared to be extending into the capsule, but for the most part the tumor was well confined. There was a discrete focus of hemosiderosis along with recent hemorrhage in the capsule. In other sections the tumor showed marked focal mucoid stroma, and in some areas the stroma had an appearance suggestive of cartilage (Fig. 4). In these sections the small ducts resembling follicles were scattered and were rather discrete. They contained small globular masses of pale pink, amorphous to finely vacuolated material. Occasional plasma cells were seen between the follicles.

Diagnosis: Malignant (low grade) mixed tumor of the parotid gland.

COMMENT

Once all the factors that may cause a parotid swelling are eliminated, surgical intervention is essential for a positive diagnosis. Regardless of the behavior of the swelling, definitive therapy should be instituted without the benefit of a preoperative gland biopsy.[1]

In the case just described sialograms and re-exploration of the body of the mandible plus the relatively asymptomatic history gave no corroborative evidence as to the nature of the parotid tumor. The gross specimen weighed 30 grams and measured 9 by 3 by 1.5 cm. The theory that a weakened parotid gland better supports chronic infection may have played a part in the persistent lymphadenitis.[2]

Foote and Frazell[4, 5] have established that the transition from a hitherto benign to a fully malignant tumor can occur at any time. One should therefore, approach this entity with the same attitude as the surgeon who approaches right lower quadrant pain, knowing that the diagnosis of appendicitis will not always be correct but that the risks of withholding surgery exceed those associated with surgical exploration.[1]

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946 Rose Bldg.

NEURINOMA IN THE VESTIBULAR MUCOSA

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Salinas, Calif.

NEURINOMAS (also known as neurilemmomas or Schwannomas) are regarded as tumors of Schwann cells which are formed from the very thin sheath, the neurilemma or sheath of Schwann, which encases each myelinated fiber. These tumors are generally benign.

CASE REPORT

A 25-year-old woman was referred because of a possible apical abscess of the upper right lateral incisor.

History.—The patient stated that she had noticed a swelling in the upper lip for about one year. She intended to mention this to her physician but always forgot to do so. About three months previously she hit her upper lip while playing with her children, and since that time the swelling had constantly increased.

Oral Examination.—Examination of the patient's mouth revealed a perfect dentition. The oral mucosa was negative with the exception of the mucosa of the vestibule above the gingiva of the upper right lateral incisor. In this area there was a swelling, about 2 cm. in its greatest diameter and completely circumscribed by a hemorrhagic area (Fig. 1). The area felt hard and movable on palpation. The mass extended from the mucogingival junction to the inferior border of the nose and caused the bulging of the nasal mucosa, partly closing the right nostril (Fig. 2). The patient experienced no pain or discomfort.

General physical and roentgenographic examinations were negative.

Operation.—On June 4, 1958, the right and left anterior superior alveolar nerves and the nasopalatine nerve were anesthetized with a 2 per cent Xylocaine solution containing epinephrine 1:100,000. An incision was made at the mucogingival junction, extending from the right central incisor to the upper right cuspid. The mucosa was dissected upward and exposed a rounded, firm mass (Fig. 3). It was pale yellow and covered with a thin fibrous capsule. The mass was held with an Ellis forceps and dissected free (Figs. 4, 5, and 6). Its superior border contained two blood vessels which were ligated and then cut. The mass was removed, and the cavity which remained showed no pathology. There was no destruction of bone in this area. The blood vessels that were ligated seemed to originate from the nasal septum. The mucosa was then sutured with interrupted black silk sutures (Fig. 7).

Pathology Report.—

Gross: This specimen was a rounded, firm mass, measuring 3 cm. in length and 1.5 cm. in breadth (Fig. 8). It was pale yellow and had a thin external fibrous capsule. The

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Fig. 1.—Note swelling completely circumscribed by a hemorrhagic area.

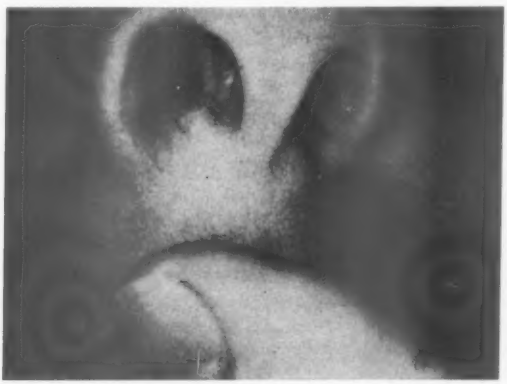

Fig. 2.—Bulging of nasal mucosa, partly closing right nostril.

Fig. 3.—Exposed tumor mass.

Fig. 4.

Fig. 5.

Fig. 6.

Figs. 4, 5, and 6.—Tumor mass as it was dissected free.

cut surface showed uniform, finely granular, pale yellow tissue which was also firm. Two cross sections were taken for microscopic study.

Microscopic: The tumor had a definite fibrous capsule which was thin but apparently intact. The body of the structure was made up of peculiarly arranged bundles of cells which showed a strong tendency to palisading of nuclei. The nuclei were uniform in most cases and showed no unusual mitotic activity. Occasional moderately large and irregular

Fig. 7.—Mucosa sutured.

Fig. 8.—Tumor mass removed for pathologic study.

nuclei were encountered in more cellular areas. These nuclei were associated with strands of tissue of fibrous and nerve sheath origin. The structure was judged to be benign, but it probably had local recurrence potentialities.

Diagnosis: Neurilemmoma, benign.

CONCLUSION

A neurinoma (neurilemmoma, Schwannoma) can occur along any nerve fiber. After an extensive investigation of the literature, however, we find that the neurinoma described in the foregoing case report is the first such tumor reported that has occurred in the vestibular mucosa and involved the floor of the nose.

CONDYLAR HYPERPLASIA

Report of a Case

Marcos Dones, D.D.S., B.S., San Juan, Puerto Rico*

THE etiology of mandibular condyle hyperplasia is unknown. Many ascribe this deforming disease to exostosis, osteoma, or trauma in the temporomandibular joint occurring at some time during the life of the patient. Systemic factors can be eliminated, since there is no enlargement in any other bone.

The condition is manifested by facial deformity characterized by deviation of the chin away from the enlarged condyle, cross-bite, and separation of the teeth when the joints are closed in centric relation. In some instances there is a forward projection of the chin, with disabling pain accompanying mastication or movements of the mandible.

CASE REPORT

The patient, a 25-year-old man, had facial asymmetry of ten years' duration (Fig. 1, *A*). During the last four months the asymmetry had grown more noticeable. The patient was prognathic (Fig. 2, *A*); he had increasing difficulty with mastication and suffered almost intolerable pain over the region of the left ear. When examined on Nov. 26, 1956, for admission to the San Juan City Hospital, the patient was suffering from intolerable pain, facial asymmetry, and malocclusion (Fig. 3, *A*). Laboratory examinations were essentially negative for any systemic disease. Roentgenographic examination revealed asymmetry in the configuration of the mandible; this was most prominent in the condyle, with the left one seen to be unusually long.

On Nov. 27, 1956, the patient was taken to the operating room of the San Juan City Hospital for excision of left condyle (condylectomy). Under general endotracheal anesthesia, the left temporomandibular joint was exposed through a preauricular incision and the left condyle was resected after several drill holes were made at its base to facilitate excision. Interdental wiring with rubber-band traction was used to immobilize the patient's mandible for two weeks. Postoperative edema resulted in a left facial weakness, but this has gradually disappeared. The cosmetic result was satisfactory (Figs. 1, *B* and 2, *B*), and the occlusion was greatly improved (Fig. 3, *B*). Mastication and general function of the mandible were satisfactory. Pain at the temporomandibular joint, earaches, and general malaise disappeared completely.

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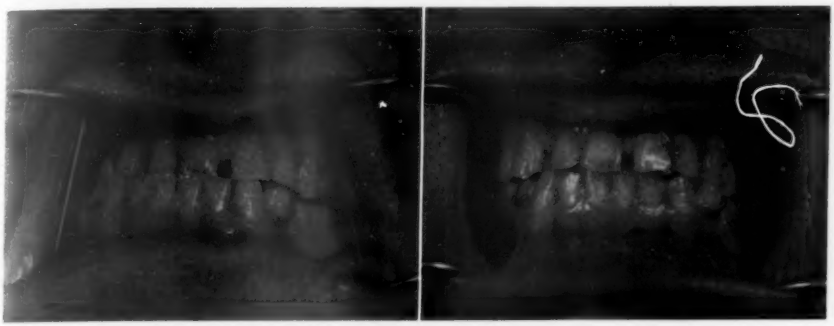
A. *B.*

Fig. 1.

A. *B.*

Fig. 2.



A. *B.*

Fig. 3.

The asymmetry, intolerable pain, and reduction of functional capacity of the mandible due to condylar hyperplasia make surgical correction imperative in cases of the type just described. I have found that condylectomy as performed in this patient gives the best results, cosmetically and functionally.

LIPOMA IN THE FLOOR OF THE MOUTH

Report of a Case

Harris Blake, D.D.S., and Fred S. Blake, D.D.S.,** Paterson, N. J.*

THE lipoma is a tumor consisting of adult fat cells grouped into lobules by vascular fibrous connective tissue septa. It is slow growing and benign, but it may reach a large size. In the oral cavity the tumor forms from fat cells in the buccal space, the tongue, the floor of the mouth, the pharynx, and the parotid glands. The lesion is usually solitary, but examples of multiple lesions are not uncommon. Many fatty tumors contain fibrous connective tissue in excess of that needed for the supporting stroma, and these are termed "fibrolipomas."

Lipoma in the floor of the mouth is exceedingly rare. The usual swelling in this area is due to the retention cyst (ranula), and a differential diagnosis should be made.

CASE REPORT

A 50-year-old white woman was referred on Feb. 16, 1955, for examination and treatment of a swelling in the floor of the mouth under the tongue. The patient stated that the lesion had first appeared six months previously; it had increased in size during the first month but had not grown since. However, she had not sought treatment until the present time.

The patient was a well-developed woman in no distress. Extraoral examination showed the tissues to be normal in appearance and texture. There was no pain on pressure, and there were no palpable lymph nodes. Intraoral examination revealed a prominent swelling in the anterior part of the floor of the mouth under the tongue on the right side (Fig. 1). The mucosa overlying the swelling was shiny, smooth, and translucent in appearance. It was soft and slightly compressible, nontender, and noninflammatory. The remaining oral mucous membranes were normal in appearance. Oral hygiene was good.

Roentgenographic examination showed no evidence of salivary calculi. The family history and past medical history were of no apparent significance.

Operation.—On Feb. 21, 1955, the following operation was performed: Under local anesthesia, an incision 1.5 cm. in length was made through the tissue overlying the lesion. The mucosa was divided, exposing a yellowish tumor mass. This was dissected free and removed. The mucous membrane was closed with four interrupted 000 silk sutures, and the specimen was sent for histopathologic examination.

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Fig. 1.

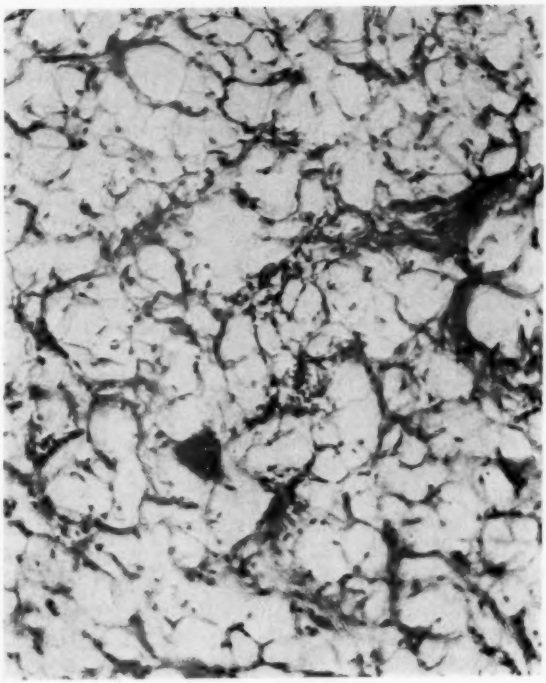

Fig. 2.

Pathologist's Report.—Margit Freund, M.D., of the New York Institute of Clinical Oral Pathology examined the specimen and reported as follows:

Gross: A soft, elastic, buff mass received in fixative measures 17 by 15 by 13 mm. On section, the cut surface is yellowish in color.

Microscopic: Section shows lobules of mature fat tissue without any evident capsule. A minimal amount of connective tissue separates the fat lobules. The capillaries are engorged (Fig. 2).

Diagnosis: Fibrolipoma.

Course.—The patient was given sedation for pain and instructed to keep the area clean with saline irrigations. She returned the following day with slight swelling but no unusual pain or discomfort. The sutures were removed on the fourth postoperative day, and recovery continued uneventfully.

COMMENT

A tumor which is very rarely found in the floor of the mouth has been described. The usual translucent swelling in this area is caused by a retention cyst (ranula). In this case, once the initial incision had been made, it was evident that we were dealing with a neoplasm rather than a cystic lesion.

These tumors can be removed without danger of recurrence, although care should be taken that the entire lesion is removed. The lipomas very rarely, if ever, undergo malignant transformation.

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17 Church St.

PERIODONTICS

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ROOT SURFACE RESORPTION OF PERIODONTALLY DISEASED TEETH

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Root resorption has been described by many investigators. A review of the literature on this subject can be found in the publications of Henry and Weinmann[1] and Steadman.[2] Henry and Weinmann examined 261 teeth under the microscope and found that 236 of these, or 90.5 per cent, showed some resorption. They further noted the types of resorption, their anatomic location, and the average number of resorption areas for each tooth. Root surface resorption and repair have also been described in relation to orthodontic treatment and trauma.[3-5] There are a number of references with regard to root surface resorption of periodontally diseased teeth,[6-12] and in these cases it has been related to an inflammatory process in the periodontal membrane. Gottlieb[13] felt that, in addition to inflammation, the root surface itself may give rise to resorptive processes. Henry and Weinmann also found that inflammation, per se, did not cause root resorption. The greatest number of resorptions, 76.8 per cent, occurred at or near the apex where no inflammatory changes could be seen and not at the gingival margin where inflammation and pockets were commonly seen.

With the possible exception of the work by Hürzeler and Zander,[14] there are no data available which compare on a large number of teeth the incidence of root surface resorption on periodontally diseased teeth with that on teeth that are periodontally healthy. Hürzeler and Zander studied cementum thickness of healthy teeth and of periodontally diseased teeth and came to the conclusion that teeth with healthy periodontal tissues have a much higher rate of cementum apposition with age than teeth surrounded by diseased periodontal tissues. Their study on cementum thickness did not just measure continuous cementum apposition if one takes into consideration the fact that cementum thickness could also be altered by the occurrence of cementum resorption. Because there seems to be no observation in their publications on

From the Eastman Dental Dispensary, Department of Periodontology.
This study was conducted under U. S. Army Contract DA-49-007-MD-857, at the Eastman Dental Dispensary, Department of Periodontology.

whether or not cementum resorption occurred, we undertook to study the areas of resorption on the same material that was used by Zander and his associates for measuring cementum thickness.

MATERIALS AND METHODS

For the determination of cementum resorption we studied microscopically 299 teeth which comprised three different groups: Group I, teeth with a healthy periodontium; Group II, teeth which had deep pockets around them before extraction; and Group III, a group of teeth from India. These teeth were divided into four age groups: 21 to 30, 31 to 40, 41 to 50, and over 50. All the teeth were single-rooted. They were fixed in formalin, decalcified, embedded in celloidin, sectioned serially from the apex to the cementoenamel junction, and stained with hematoxylin and eosin.

We studied every twentieth section, starting with the tenth section from the apex and ending with the first section that showed the cementoenamel junction. Using this method, we did not investigate the entire root surface but obtained a representative sample of each tooth. Drawings were made of each of the sections at a magnification of 25X under a projector microscope. The circumference of each section was measured, as was the length of the resorbed areas in each section. The large areas were measured on the drawings by a map measurer after "the diagnosis had been made in the microscope," and the small areas were measured directly by an optical measuring device in the microscope. The total length of resorbed circumference for each tooth investigated was expressed as a percentage of its total circumference, and the resorbed areas in all sections for each group were counted and expressed as an average number per tooth.

TABLE I. ROOT RESORPTION

	GROUP I HEALTHY TEETH				GROUP II PERIODONTALLY DISEASED TEETH				GROUP III TEETH FROM INDIA			
Age group	21-30	31-40	41-50	Over 50	21-30	31-40	41-50	Over 50	21-30	31-40	41-50	Over 50
Number of teeth	18	27	36	37	10	13	21	37	18	27	18	37
Average number of resorbed areas	1.4	1.4	2.0	3.5	1.6	3.1	4.0	6.0	5.0	3.7	5.4	12.2
Percentage of circumference resorbed	0.5	0.6	0.9	1.8	1.0	1.8	3.5	5.0	4.6	3.0	5.0	6.8

RESULTS

It was found that 80 per cent of the healthy teeth (Group I) studied showed resorption. Resorption was seen in 91 per cent of the periodontally diseased teeth (Group II) and in 97.5 per cent of the teeth from India (Group III). More meaningful are the figures which are assembled in Table I. There one can see the average number of resorption areas per tooth for each group

and the percentage of the root circumference on the sections studied that was resorbed. It is quite obvious that in both the periodontally diseased group and the group of teeth from India a significantly larger amount of the circumference was resorbed than in the healthy group.

Fig. 1.—Cementum fractured at the cementodentinal junction and lying in the periodontal tissue.

Fig. 2.—Cementum change similar to that shown in Fig. 1 but with fracture within the cementum.

In addition to cementum resorption, the periodontally diseased group and, to an even greater extent, the group of teeth from India show other cementum changes. These changes are illustrated in Figs. 1 and 2. Fig. 1 shows a piece of cementum fractured at the cementodentinal junction and lying in the periodontal tissue. This occurrence is considered by many investigators to be due to acute occlusal trauma.[15-18] A cementum change similar to that in

Fig. 1, but with a fracture that had occurred within the cementum, can be seen in Fig. 2. For the purpose of this study, the areas illustrated in Figs. 1 and 2 were not counted as areas of resorption since we felt that they were probably cementum tears or defects. Nor was the type of cementum loss due to erosion or abrasion counted.

DISCUSSION

Had areas such as those demonstrating these three types of root surface alteration been counted, the difference between the group of healthy teeth and the other two groups would be still greater than that shown in Table I. Moreover, these three types of root surface alteration are probably responsible for the findings reported by Hürzeler and Zander[14] and Müller and Zander[19] of differences in cementum thickness between healthy teeth, periodontally diseased teeth, and teeth from India.

It would be interesting to speculate whether the amount of root resorption found in this study on teeth from India (five times that of healthy teeth) was due to the common occurrence of periodontal disease in that country. That is the most likely explanation, since periodontally diseased teeth in the United States showed about three times the amount of resorption shown by the healthy teeth.

In this study most of the resorption areas were located in the apical third of the teeth studied. This finding agrees with Henry and Weinmann[1] and indicates that resorption on periodontally diseased teeth and teeth from India cannot be blamed solely on inflammation.

This study emphasizes the need for further investigation of the cementum, such as a study of possible qualitative differences between cementum on healthy teeth and that found on the teeth of the two other groups studied. Gottlieb's hypothesis that periodontal disease may be a disease of the cementum still remains to be proved.

SUMMARY

Investigation of resorption areas on the roots of three groups of teeth—118 healthy, 81 periodontally diseased, and 100 teeth from India—showed three times more root surface resorption on periodontally diseased teeth and five times more on teeth from India than on healthy teeth. Other types of cementum changes or loss were also noted.

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ORAL MEDICINE

TREATMENT OF DESQUAMATIVE GINGIVITIS

Report of a Case

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A WHITE Italian married woman, 44 years of age, complained of a burning sensation and bleeding from a blistering ulceration on the buccal mucosa. The lesion had persisted for two years with numerous acute flare-ups.

Prior to treatment at this office, the patient had been treated with electrosurgery of the area, parenteral administration of hormones, vitamins, and antibiotics, none of which afforded her any appreciable relief.

The present bullous ulceration was of three months' duration. When the bulla ruptured, it would discharge a serosanguineous fluid. At the time of examination the patient was under severe physical and emotional stress.

Fig. 1.—Area of desquamative gingivitis prior to treatment.

Trauma resulting from the mastication of hot solid food would cause the area to bleed severely; this forced her to adopt a bland semiliquid diet which she ingested through a straw.

Medical examination and laboratory work-up were noncontributory.

Personal History.—The patient was born in Italy of Italian parentage. She married at the age of 22. She has two sons, both of whom are in good health.

Previous Medical History.—The patient reported that she never had "regular periods." She had been treated for "stomach trouble" for the past eleven years. Three years previously she was told by her physician that she was starting her "change of life."

Examination.—A lesion (Fig. 1) was seen to extend from the mesial aspect of the upper left central incisor to the distal aspect of the upper left cuspid pontic. In height it extended into the mucobuccal fold. The bullous area in

Fig. 2.—Clinical appearance of the area six months after treatment.

the center was covered by a thin, glistening membrane. The tissue was completely devoid of stippling. The desquamative tissue was easily lifted from the mesial surface of the central incisor to the periphery of the lesion. There was a clear line of demarcation between normal and diseased tissue. The underlying bed of tissue had a bluish red color. Blood oozed profusely from the denuded area.

Clinical diagnosis: Desquamative gingivitis.

Treatment.—The patient was given the following prescription:

Premarin liquid (conjugated estrogens), 2.0 c.c.
Hydrocortone, 0.03 Gm.
Terramycin (soluble tablet), 0.9 Gm.
Oil of peppermint, 0.1 c.c.
Aquaphor, q.s. 30.0 Gm.
Sig.: Apply to area as directed.

She was instructed to peel away the desquamative epithelium upon arising. The resulting bleeding was stopped with gauze pads and digital pressure. Warm water (110° F.) was held in the mouth for three minutes (the increased

temperature dilated the capillaries and aided the flow and absorption of the drug). With a rubber finger cot, she massaged a demonstrated amount of ointment into the denuded area three times daily. In addition to the local treatment, the patient was placed on 300 mg. of ascorbic acid daily. Within two months after initiation of treatment, the pathologic tissue appeared to be reverting to a normal character. The patient no longer complained of the burning sensation.

During the third month the ointment (without the Terramycin) was applied once daily. During the fourth month, the ointment was applied every third day and then discontinued.

Six months later the area appeared clinically cured (Fig. 2).

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ORAL ANATOMY AND PHYSIOLOGY

VENOUS DRAINAGE OF THE MANDIBLE

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THE venous drainage of the mandible has attracted little attention in the past. Zuckerkandl[5] says that the mandibular veins form a network around the inferior dental artery and drain into the pterygoid plexus. Buchanan[4] and Gray[2] state that there is only one inferior dental vein, while Cunningham[1] observes that the venae comitantes of the inferior dental artery almost fill the mandibular foramen. No mention is made in the literature of the periosteal system of veins.

Harrison and Gossman[3] injected roentgenopaque material into the cancellous bone of the extremities to demonstrate the venous drainage of the bones. Their observations were made on the cadavers of three men and three women forty-eight to seventy-two hours after death. They found that a suspension of barium sulfate (Micropaque, Damancy & Co., Ltd.), when used for injection, provided better contrast roentgenographically. These workers used a sternal puncture needle or a lumbar puncture needle ground so as to produce a symmetrically sharp point. This was pushed through the skin and tapped into the underlying bone with a hammer. It was noted that the trocar could be withdrawn quite easily, once it had perforated the compact bone and the needle had become embedded within the cancellous bone; until then, the trocar could not be withdrawn except forcibly. A syringe containing the roentgenopaque medium was attached to the needle and the injection was made.

Harrison and Gossman made injections in a variety of situations, using 5 to 10 ml. of roentgenopaque material. They noted that more could have been injected. The site of investigation was roentgenographed immediately after the injection, which never took more than forty-five seconds.

MATERIALS AND METHODS

I decided to employ the above technique to demonstrate the venous drainage of the mandible in cadavers. Six cadavers were used forty-eight hours after

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death. The needle was inserted on the buccal aspect of the mandible posteriorly. An intraoral approach was employed in order to avoid wounding the facial skin. It was found that hammering the needle into the bone was difficult and caused the needle to bend. The most satisfactory injections were made with a modification of the Sahla needle. The trocar point of the needle was replaced by a hollow trephine. By means of hand pressure, a hole was made through the cortical bone into the underlying cancellous bone. The needle was withdrawn and the small piece of bone in the trephine was removed with a wire. The Sahla needle was then reinserted and connected to a 20 ml. Luer syringe containing Micropaque, and 5 ml. of the Micropaque was injected into the mandible.

The site of the injection and the ascending ramus of the injected side were roentgenographed immediately after the injection.

Fig. 1.—Roentgenogram of the right side of the mandible of a cadaver injected with Micropaque. Note needle in situ. (Three-eighths natural size.)

OBSERVATIONS

Fig. 1 shows a network of vessels in the bone and soft tissues filled with Micropaque. As the injection was made directly into the bone, most of the visible vessels must be within the bone. Some of the vessels converge and pass into the facial veins. The actual filling of the latter was proved by dissection. The anterior and posterior facial veins and the external jugular vein were found to contain Micropaque. Because of the risk of damage to the facial skin, it was not possible to dissect medial to the ascending ramus and show the filling of the pterygoid venous plexus with Micropaque. On the roentgenogram, however, it may be seen that in the region of the ascending ramus there is a network of vessels which we may reasonably assume is the pterygoid venous plexus.

Dissection of postmortem human material has revealed the presence of a number of inferior dental veins accompanying the artery of the same name.

Thus, the venous drainage of the mandible is upward to the pterygoid plexus via the inferior dental veins and downward to the facial and external jugular veins. The veins of the periosteum must have a large surface area to allow the rapid flow of injection material to pass into the facial veins, and they are probably responsible for the main venous drainage of the mandible.

COMMENT

The foregoing observations are of interest in considering the metastasis of malignant tumors of the oral cavity which involve the mandible and in understanding of the pathogenesis of osteomyelitis of the mandible. The prognosis of a squamous-cell carcinoma of the gingivae or the floor of the mouth is poor when the mandible is invaded. The tumor cells are rapidly conveyed via the dense venous network in the bone to the veins of the neck and become widely disseminated via the blood stream.

A pyogenic infection of the mandible (for example, an acute apical abscess) may result in the formation of a large quantity of pus. This bursts through the cortical bone and lifts the periosteum from the bone. Thus, there is an interruption in the venous drainage via the periosteal veins. The increase of pressure within the bone will ultimately interfere with the arterial supply and result in necrosis of bone. It is unlikely that the primary cause of osteomyelitis of the mandible is a thrombosis of the inferior dental artery. If thrombosis of the artery does occur, it is probably secondary to a blockage in the venous drainage.

I should like to express my thanks to the Clinical Research Committee and the Director of the Bland Sutton Institute, Middlesex Hospital, for facilities granted in those departments. My thanks are also due Professor E. W. Walls, Mr. J. W. Schofield, and Mr. D. Greer Walker for their advice and encouragement in the preparation of this paper.

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ORAL ROENTGENOLOGY

American Academy of Oral Roentgenology

Arthur H. Wuehrmann, Editor

EXTRAORAL TECHNIQUES

The Lateral Jaw

Arthur H. Wuehrmann, D.M.D., and Aaron A. Chilcoat,** Birmingham, Ala.*

INTRODUCTION

THE general practitioner of dentistry is not prone to utilize extraoral roentgenographic procedures. Yet, an adequate diagnosis is often impossible without a knowledge of the bone architecture beyond the dimensions of the small intraoral film. Failure to examine the jaws properly is related to lack of conviction concerning the necessity of such roentgenograms, lack of interpretive ability, technical inexperience, unavailability of film in the office as a consequence of infrequency of need, and lethargy. The purpose of this article is to establish a simple, practical technique for exposing all areas of the mandible and maxilla, with the exception of the maxillary anterior segment. Large portions of the latter region can be seen most effectively by means of the occlusal film and the customary intraoral technique which utilizes the rules of geometric isometry.

TECHNICAL FACTORS

Before we discuss film placement and angulation, it appears advisable that we state specifically the recommended technical factors.

Film.—The 5 by 7 inch no-screen type of film is preferable; intensifying screens tend to reduce definition and to produce excessive contrast. The emulsion speed of these films varies with manufacturers. The suggested film is

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exposed using a cardboard film holder. Caution must be used to close the film holder properly; the large top flap must be closed first, then the sides and bottom (Fig. 1). If this order is reversed, light can leak in under the large top flap and expose that portion of the film not covered by the smaller flaps.

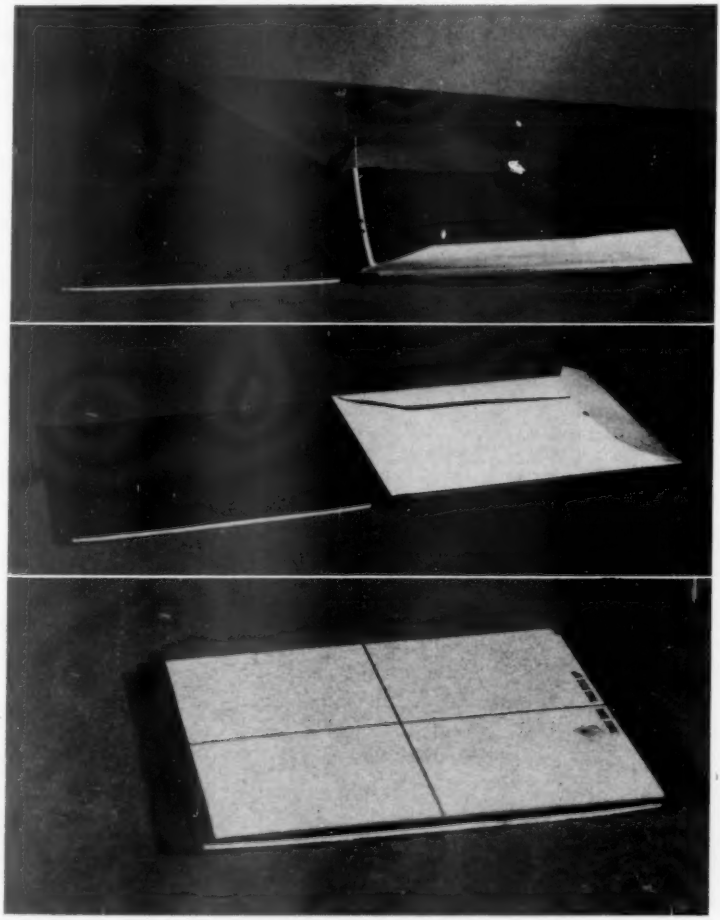


Fig. 1.

Darkroom Processing.—The technique employed is identical to that used with intraoral films, except that a 5 by 7 inch film hanger is used and the film is immersed in all solutions 50 per cent longer than are the intraoral or screen-sensitive films. Needless to say, exact and reproducible techniques must be used in processing.

Target-to-Film Distance.—An approximately 7 inch open cone, properly filtered and columnized[1] is used.* This results in a target-to-film distance of about 16 inches. The distance will vary slightly with x-ray machines and with the width of the patient's face.

Exposure Factors.—Most dental x-ray machines operate at 60 to 65 KVP and 10 Ma. Because of timer inadequacies and/or differences in the efficiency of the machines (even those of the same make and model), an exact exposure time cannot be stated. However, average exposures (Table I) can be recommended with the expectation that the operator will make the necessary alterations.

The factors shown in Table I were used with Ansco non-screen film, a 16 inch target-to-film distance, and 2.5 mm. of aluminum filtration.

TABLE I

KILOVOLT PEAK	MILLIAMPERES	A* (SECONDS)	B† (SECONDS)
60	10	1-¾	2-¾
65	10	1-¼	2-¼
90	10	⅓	⅘
90	15	⅓	½

*All areas of mandible and maxilla except the mandibular midline.
†Mandibular midline (greater distance and tissue thickness necessitate increased exposure values).

ANGULATION AND FILM PLACEMENT

Shadow Casting.—As in any type of x-ray film technique, extraoral procedures employ the principles of shadow casting. The intention is to cast the shadows of the desired structures onto the x-ray film and the shadows of the undesired structures somewhere other than onto the anatomy under study. The use of a human skull with a hinged mandible is invaluable when studying and planning extraoral views of the head. If one uses only one eye to view the object, this eye can represent the target of the x-ray machine (that is, the source of radiation), and the operator can visualize and anticipate the appearance of an x-ray film exposed using similar angulation. Fig. 2 demonstrates a view of the mandibular molar region of a mandible as seen through an ordinary 7 inch open-end dental x-ray cone fitted with a diaphragm having a ¾ inch opening in the center. The eye (camera) was placed approximately 3 inches back of the diaphragm opening.

It is pertinent to restate without further comment the five basic rules for shadow casting. If the reader does not understand the underlying reasoning, it is essential that he review these fundamentals, which may be found in most high school or college physics texts. The rules for roentgenographic shadow casting accuracy are as follows:

1. The source of radiation should be as small as possible.
2. The distance from the source to the object should be as long as practical.

*A total inherent plus external filtration of 2.25 mm. of aluminum should be used, and the beam of radiation should be columnized through the use of a lead diaphragm so that a circle of exposure having a diameter of no more than 5 inches will be produced on the film.

3. The distance from the object to the film should be as short as possible.

4. The object and the film should be parallel.

5. The central ray should strike both the object and the film at right angles.

Compromise of these rules is usually unavoidable in extraoral roentgenographic techniques, but every effort should be made to vary as little as possible from these standards.

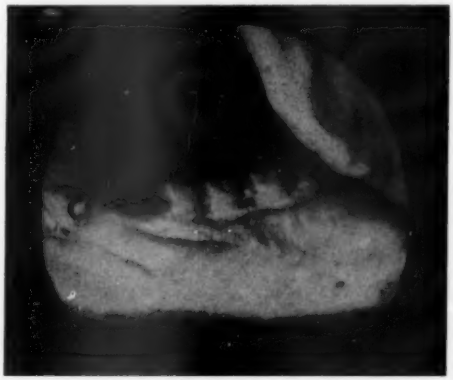
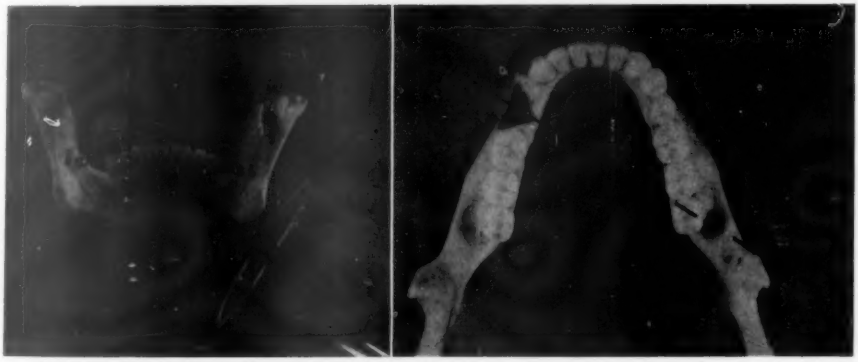


Fig. 2.



A. *B.*

Fig. 3.—The mandible viewed from postero-anterior (*A*) and superior-inferior (*B*) aspects shows the angulation of rays when the mandibular molars are being exposed. The round dot locates the fixed point at the angle of the near mandible; the triangle shows the point anterior and superior to the area in question. The latter point is moved according to the area being examined.

Angulation.—The lateral jaw technique is based on a constant procedure whereby the central ray is directed through two anatomic landmarks. One of the landmarks changes, depending on the area under surveillance, but the principles of the technique do not vary. The central ray is directed through a

point (the stationary landmark) just distal and inferior to the angle of the mandible nearest the x-ray source and through a second point on the side being examined (the movable point) which is just anterior and superior to the area in question (Fig. 3). In this manner, the near mandible (nearest to the x-ray source) is cast above and anterior to the region under observation. The only other osseous structure which could be superimposed on the diagnostic area is the vertebral column. Such superimposition is minimized by extending the patient's chin upward and forward and by avoiding any turning of the head; the head may be tipped to avoid interference of the x-ray cone with the shoulder on the near side, but it may not be turned. Fig. 4 shows the type of roentgenogram that is produced by this technique. Note that the circle or dot is superimposed on the triangle, and both are approximately centered in the exposure circle. A dried specimen has been used for these purposes, but equally satisfactory films can be obtained in living subjects (Fig. 5).

Fig. 4.

Several examples will clarify the angulation procedures. If the area in question included the right mandibular molar teeth and associated bone, the central ray would be directed through a point just distal and inferior to the angle of the mandible on the left side and through a point just above the occlusal surface of the mandibular right second premolar. If the mandibular midline and the teeth to the right of the midline were in question, the movable point would now be over the incisal edge of the left mandibular central incisor, and the fixed point would be inferior and distal to the left mandibular angle. The view of the midline taken from the right side (for the area to the left of the midline) would have as its fixed point a spot just distal and inferior to the right

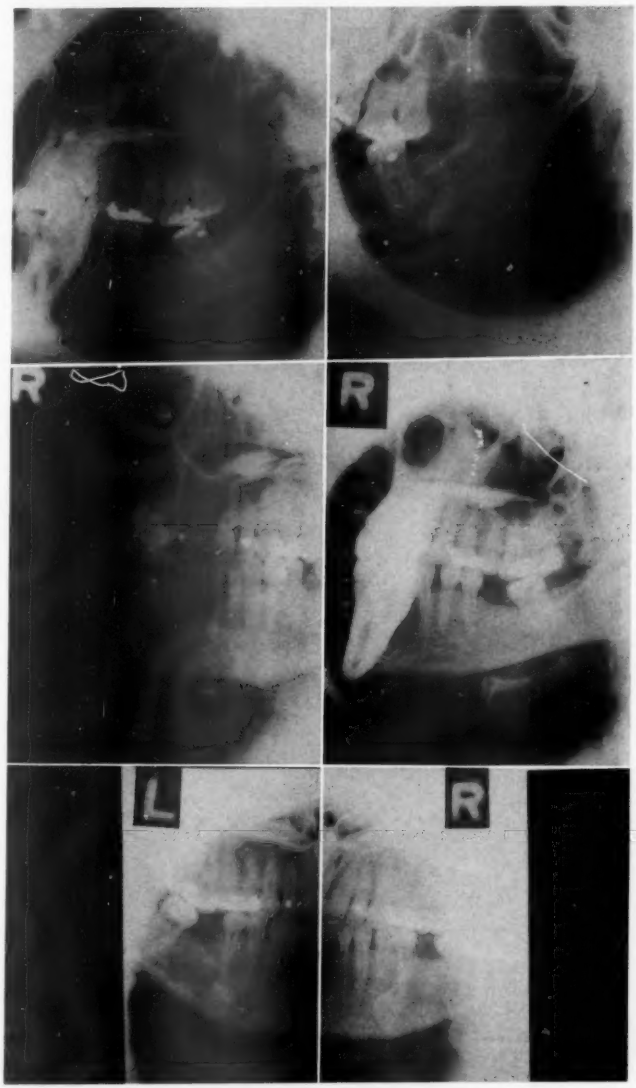


Fig. 5.—Lateral jaw coverage with the technique described in this article.

Fig. 6.—The film is placed after the proper angulation has been determined. *A*, The film in the cardboard holder is held by the heel of the hand placed on the cardboard holder directly over the zygoma. Care is taken to have the exposure side of the holder touching the face. *B*, The film is held as nearly parallel with the long axis of the teeth as possible. It is parallel with the midsagittal plane of the head, except that it is also rotated about the face, so that (*C*) from a horizontal standpoint, it is perpendicular to the path of the central ray as it emerges from the cone. Care is taken in *B* to avoid exact perpendicularism of the ray and film, since this would unduly increase the distance between the object and the film; similarly, the film is not allowed to contact the tissues firmly over the mandible, since that would remove all semblance of perpendicularism between ray and film.

mandibular angle, with a movable point over the incisal edge of the right mandibular central incisor. Usually views of the midline include two exposures of the midline, one from each side of the face. Such films are then appropriately cut at the midline and pieced together (see lower section of Fig. 5). If the area in question were the maxillary right cuspid area, the fixed point would be distal and inferior to the left mandibular angle and the movable point would be over and just superior to the apex of the right maxillary lateral incisor.

Film Placement.—Ideally, the film should be placed parallel to the structures being observed and the central ray should be directed at right angles to both. Such a relationship of the central ray to the tooth would clearly superimpose the near side of the mandible on the side being examined. The procedure described above permits the minimum amount of compromise with regard to perpendicularism of the ray and object.

The film is placed after the x-ray machine has been properly angulated. Care is taken to place the exposure side of the film holder against the skin. It is quite possible to place the film so that the ray strikes it at right angles. This necessitates holding the film away from the body of the mandible in a "tentlike" fashion, however, and unnecessarily increases the object-to-film distance. Therefore, the film is placed parallel to the midsagittal plane and is then rotated around the face until the ray strikes the film at right angles in a horizontal plane; in the vertical plane the ray strikes the film at the smallest practical angle away from 90 degrees. The film is supported with the heel of the hand on the film holder approximately over the zyomatic bone and with the fingers resting comfortably on the side and top of the head. The center of the film is usually placed over the movable orientation point (Fig. 3, triangular area). The film should not be placed flat on the side of the jaw in a "reverse tentlike" fashion, for this will create image distortion and will be evidenced by an elliptical appearance of the exposed area. Overangulation will also result in an elliptical image; naturally, this also is to be avoided. Fig. 6 illustrates the principles of film placement in relation to previously determined angulation factors.

SUMMARY

A simple procedure for examining roentgenographically the entire mandible and the maxilla, with the exception of the midline area, has been explained. Several illustrations have been included for purposes of clarification.

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ROENTGENO-QUESTIONS

Can more contrast be obtained by developing dental x-ray films longer than three minutes?

Yes. Longer developing will often produce more contrast in dental x-ray films. The instructions accompanying films purchased from many manufacturers suggest exposure times based on a three-minute developing period at a given temperature. Actually, most dentists overexpose and underdevelop films. This not only exposes the patient to unnecessary radiation but does not bring out all the best diagnostic qualities of the film when it is developed. It is best to expose the film the optimum time suggested by the manufacturer and then develop it fully, so that the maximum diagnostic qualities are obtained. Often eight minutes of development will reveal a better image than five minutes. A properly timed exposure of a film will not result in the film's being too dark if developed five minutes or even longer, and it usually has better diagnostic qualities. A film exposed to optimum amounts of radiation cannot easily be overdeveloped. Longer development (full development) will produce greater density (blacks or blacker blacks) which will enhance film contrast. Equally important is the fact that an incompletely developed film does not show all the important detail that has been impressed into the emulsion. On an average, it takes about one and one-half minutes for the developer to get into the emulsion to work; hence, a three-minute developing time is essentially only one and one-half minutes of developing.

How much faster are the fastest dental x-ray films than the intermediate-speed films?

Dental x-ray films have no index rating of their film speed, as do photographic film emulsions. Each manufacturer's films are somewhat different. However, one manufacturer's fastest film is more than four times as sensitive as the intermediate-speed film and about twelve times faster than the slowest film. Using the fastest film practically possible is the easiest and one of the most effective ways of reducing radiation to the patient, preventing moved films, and showing more detail.

The American Academy of Oral Roentgenology solicits from the readers of ORAL SURGERY, ORAL MEDICINE AND ORAL PATHOLOGY any questions which deal with technical or interpretive aspects of oral roentgenology. These questions should be sent directly to the editor of this section, Dr. Arthur H. Wuehrmann, School of Dentistry, University of Alabama Medical Center, Birmingham, Alabama; the editor will distribute them for reply to a suitable group within the Academy. Questions, with the answers, will be published at as early a date as possible in "Roentgeno-Questions." Questions, especially those of an interpretive nature, should ordinarily be accompanied by good-quality roentgenograms and a pertinent history. The names of the questioner and the respondent will not be published.

ORAL PATHOLOGY

PRIMARY HEMANGIOSARCOMA OF THE JAW

Patrick D. Toto, D.D.S., M.S., and John Lavieri, D.D.S., Chicago, Ill.

THE hemangiosarcoma is synonymous with hemangioendothelioma and endothelioma, and it is closely related to Kaposi's sarcoma. The hemangioendothelioma and Kaposi's sarcoma are considered locally malignant tumors. Histogenetically, the hemangiosarcoma includes the endothelial cells and its supporting connective tissue. In Kaposi's sarcoma there is found a great component of malignant fibroblasts with the endothelial cells, but in the hemangioendothelioma or endothelioma the malignant component is restricted to the endothelial cells alone. Unfortunately, the term "hemangioendothelioma" is also used in dealing with a nonmalignant variety of tumor. It can be understood that a tumor composed of immature vascular channels and aggregates of endothelial cells not forming any lumen should be called a hemangioendothelioma. However, since it proliferates and invades the adjacent connective tissue, it may be considered locally malignant. Also, when there are the cytologic criteria of numerous and typical mitotic figures, hyperchromatism, and pleomorphism, it is considered a sarcoma.

The very nature of the hemangiosarcoma suggests metastasis by the hematogenous route. The cells lining the vascular channels may be several layers thick, and they may simply become detached and enter the circulating blood and become malignant emboli.

In the oral cavity the lesion appears as a small or large, rapidly growing tumor which has a reddish pink color, a soft to firm consistency, and a nodular surface. Ulceration with a fibrinopurulent exudate is usually found on the surface. It may closely resemble the gingival granulomatous hyperplasia seen in cases of pregnancy gingivitis and pyogenic granuloma.

The occurrence of hemangiosarcoma is rare. It has been reported in infants and young adults.[1-4] Kaposi's sarcoma is most frequently found in the subcutaneous tissue of the extremities, and rarely, it may occur in the oral cavity. The hemangioendothelioma is most frequently found in the skin at

From Loyola University School of Dentistry, Chicago College of Dental Surgery.

birth or shortly afterward. In the viscera, it has been found most frequently in the brain, bones, liver, and spleen. Like the capillary and cavernous hemangiomas, it is considered to be a developmental disturbance.

The roentgenographic appearance of bone affected by the hemangiosarcoma is characterized by the widening of the marrow spaces. When the teeth are affected, a widening of the periodontal space is noted. In the bone it appears at first as irregular diffuse roentgenolucencies. Later there are exhibited wide radiolucent bands of marrow spaces separated by roentgenopaque lines of bone trabeculae. The periodontal space becomes grossly widened, and, clinically, affected teeth are loose.

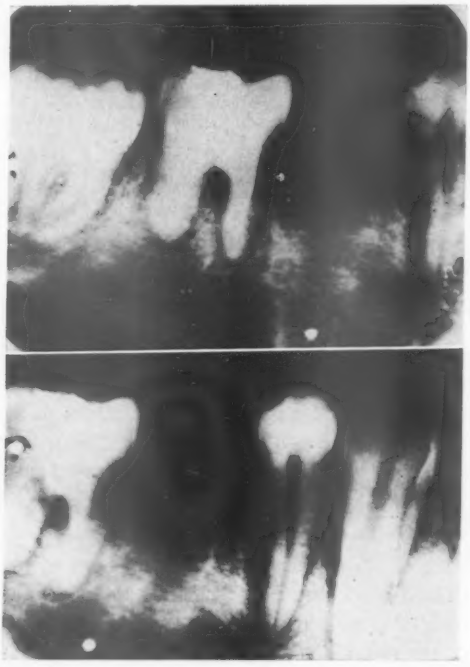

Fig. 1.—Note horizontal roentgenolucent marrow spaces extended between the widened periodontal spaces.

The histologic picture is one of dense cellularity. There are many vascular spaces of different diameters. Also, there are aggregates of endothelial cells arranged in rows and irregularly located between the vascular spaces. The use of silver stain, however, shows that the endothelial cell aggregates are always enclosed within a well-developed reticulum. Red blood cells and blood pigment are found diffusely distributed within the tumor mass. The endothelial cells lining some blood vessels appear several layers thick, and they demonstrate hyperchromatism of the nucleus and basophilia of the cytoplasm. Frequent mitotic figures and pleomorphism are seen also.

CASE REPORT

A 15-year-old girl reported to a dentist, complaining of a loose and painful lower right second premolar. The tooth was removed. A week later, the adjacent first molar and first premolar became loose, and a red, firm irregular granulomatous mass, measuring 1 cm. in diameter, was seen protruding from the operative site. The patient was referred to an oral surgeon, who hospitalized her and secured roentgenograms. At once it was noted that the periodontal ligament space was abnormally widened about the roots of the lower left first permanent molar, first premolar, and canine. Close examination of the trabecular pattern showed a peculiar horizontal widening of the marrow spaces creating roentgenolucent lines. This was most evident in the lower first premolar area (Fig. 1). Such widened lines ended in the grossly widened periodontal space.

At this time the loose tooth (the lower left central incisor, canine, first premolar, and first molar) and the red, granular, irregular mass of tissue growing from the site of the previous operation were removed and submitted for pathologic examination. The postoperative roentgenogram showed grossly widened alveolar spaces with roentgenolucency extending to the second molar (Fig. 2).

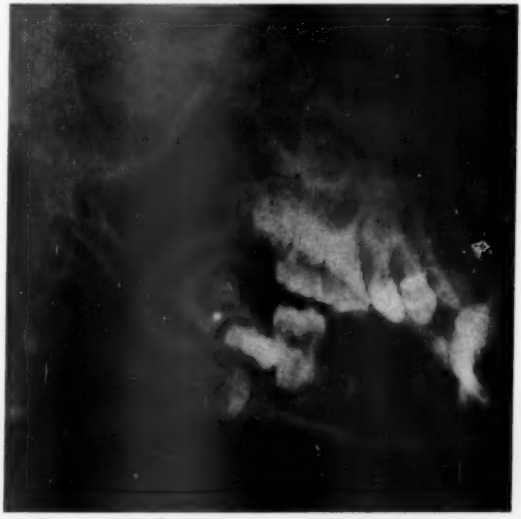

Fig. 2.—Note diffuse roentgenolucency of the widened roentgenolucent alveolar spaces.

The specimen submitted for examination consisted of several irregular, firm, brown-gray masses of tissue, the largest measuring about 1 cm. in diameter. The surface was covered by stratified squamous epithelium showing an inflammatory hyperplasia and intraepithelial infiltration by polymorphonuclear leukocytes. An ulceration of the surface was covered by a fibrinopurulent exudate. The main mass consisted of many vascular channels, some of sinusoidal character. Aggregates of endothelial cells forming no apparent structure were found between the vascular channels. Such cells demonstrated hyperchromatic nuclei and basophilic cytoplasm, frequent mitotic figures, and pleomorphism. Where a narrow lumen was discernible within a group of endothelial cells, several layers of endothelial cells lying in close proximity were observed. Detached tumor cells were found in this lumen of the vascular channels (Fig. 3). The use of silver stain demonstrated that such masses of endothelial cells actually were contained within a well-developed reticulum (Fig. 4).

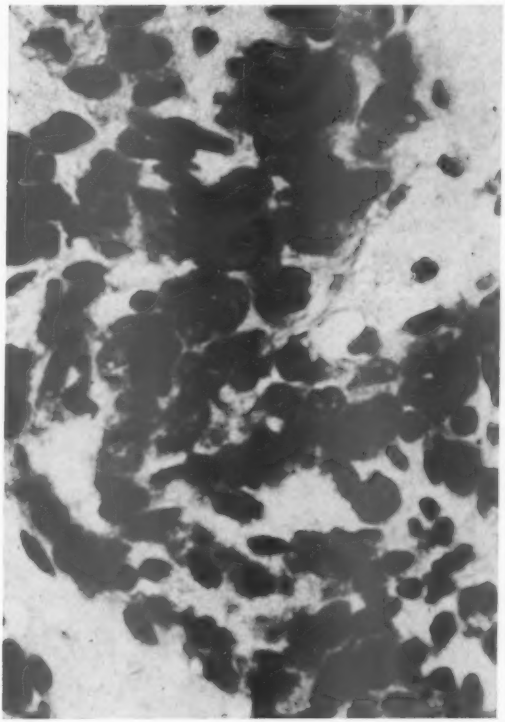

Fig. 3.—Note a malignant cell in the lumen of the capillary. Also, the cell density and hyperchromatism are abnormal.

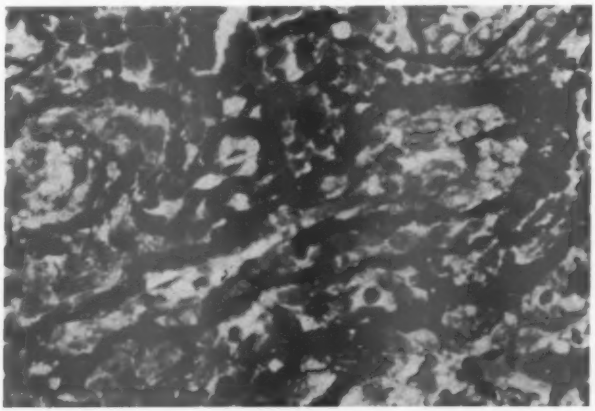

Fig. 4.—A well-developed reticulum invests the hemangiosarcoma cells.

COMMENT

This case demonstrates the urgency of recognizing the malignant nature of oral lesions characterized clinically by loose teeth and by diffuse roentgenolucency of the periodontium and alveolar bone, as seen in the roentgenogram. Also, the clinical appearance of the reddish pink granulomatous mass may be readily confused with the benign inflammatory hyperplasias, such as the pyogenic granuloma. The rare hemangiosarcoma of the mandible, reported in this case was rapidly growing through the marrow spaces, causing loss of bone and loosening of the teeth. The removal of one such loose tooth by a dentist resulted in the protrusion of a red, nodular, firm mass of malignant and granulation tissues from the socket. The patient died six weeks following removal of the teeth.

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A CASE OF NEURILEMMOMA (SCHWANNOMA) OF THE TONGUE

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CLINICAL HISTORY.—The patient, a 25-year-old man who worked as a laborer, presented himself at Bristol Dental Hospital complaining of pain in the lower molar region. The lower left first and second molars were very carious and were extracted on the same day.

A mass measuring approximately 0.5 cm. in diameter, was noticed on the tip of the patient's tongue (Figs. 1 and 2). He stated that it had been present for several years and that it had grown very slowly over this period. All he could add to this rather vague history was that it had never caused him any incovenience or pain and that there had never been any related hemorrhage.

The mass could be felt at the tip of the tongue, lying deep to the mucosa and attached to it. It extended backward and more deeply into the body of the tongue for some 1.0 to 1.5 cm. It was not tender on palpation and felt fairly firm, although two of the persons who subsequently examined it were of the opinion that it might be cystic. There was no evidence of inflammation, and the part of its surface nearest the tip of the tongue had a whitish, almost hornified appearance and texture. There was no deviation of the tongue or limitation of its movements. Speech was not affected.

A provisional diagnosis of simple tumor or inclusion cyst was made.

The patient was referred to Mr. G. M. FitzGibbon, consultant plastic surgeon at Frenchay Hospital, and later Mr. R. K. Routledge, senior registrar, Plastic Unit, Frenchay Hospital, excised the tumor under local anesthesia. Healing was uneventful.

On section, the tumor proved to be a neurilemmoma.

Pathologic Report.—The excised wedge of tongue included a firm, flask-shaped mass, 1.0 by 1.5 cm. in cross section, situated immediately beneath the epithelium (Fig. 3).

Histologically (Fig. 4), the tumor had the typical structure of a neurilemmoma, showing very well-marked palisading of the nuclei. Parts of the tumor showed considerable hyaline change, but there was no cystic degeneration.

DISCUSSION

Neurilemmoma is in most instances a solitary tumor, although occasionally it may be multiple. It may be associated with neurofibromatosis or with minor stigmata of that disease. The most common single site is in relation to the acoustic nerve within the skull. Peripherally, the tumor is usually found in relation to the main nerves on the flexor surfaces of the limbs, in the hand, neck, face, scalp, tongue, and stomach. According to Willis'[15] figures, the tumor is slightly more common in the female. There is no significant variation of incidence with age.

From the University of Bristol Dental School.

Stones[11] states that neurilemmoma of the oral cavity is of extremely rare occurrence. Stout[12] agrees but points out that the tongue is not an unusual site. Similar tumors of the tongue have been described by Willis,[15] Caponetto,[2]

Fig. 1.

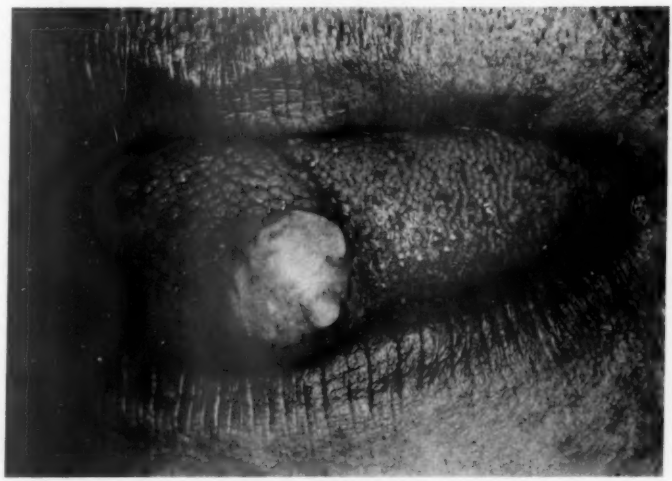

Fig. 2.

Ciantini,[3] Guillot and Moulonguet,[4] Malan,[6] Borchardt,[1] and Kaiserling[5] and in other parts of the oral cavity by Thoma,[13, 14] Zilkens,[16] Schroff,[10] Stout,[12] and Willis.[15]

The tumor has been given a multitude of names. It is now generally agreed that it does not arise from nerve cells or from their axon cylinders, so

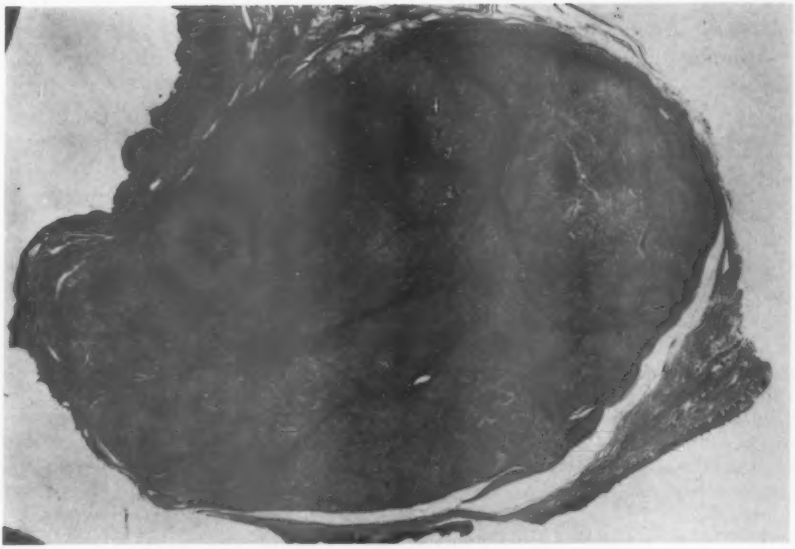

Fig. 3.—Section of tumor. (Magnification, ×9.5; reduced ⅛.)

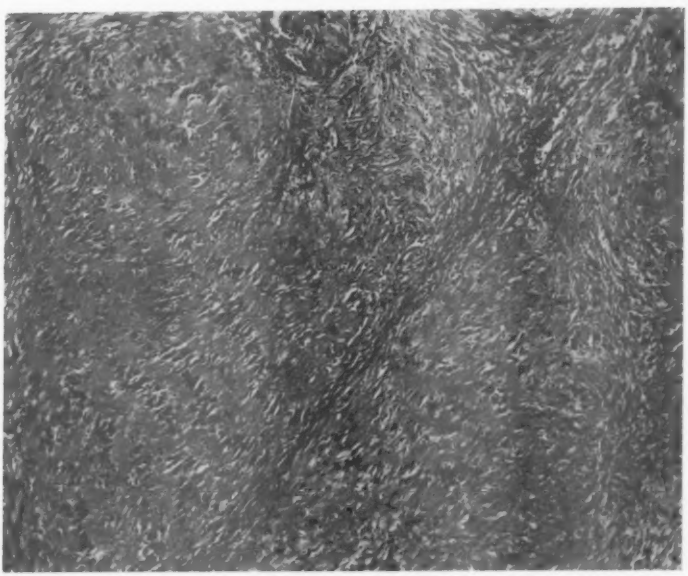

Fig. 4.—Section of tumor stained with Mallory's blue trichrome. (Magnification, ×100; reduced ⅛.)

hat, as Willis[15] remarks, the term "neurinoma" is clearly inappropriate. Masson[8] and Stout[12] named it "schwannoma" or "neurilemmoma," believing hat it arises from the schwann cells of the neurilemmal sheath, whereas Mallory[7] nd Penfield[9] preferred the name "perineurial fibroblastoma," indicating an rigin from the fibroblasts of the perineurium. The controversy over the pre- se origin of the tumor is not yet resolved.

The differential diagnosis includes a number of well-defined nodules which ay occur in the tongue, among which might be mentioned lipoma, fibroma, yxoma, mucous cyst, inclusion cyst, and organized hematoma. Clinical differ- ntiation may be impossible, and a final diagnosis rests upon histologic evidence. The tumor might produce a degree of macroglossia to be differentiated from onditions such as lymphangioma and hemangioma.

Treatment is by local excision. The tumors are characteristically well circumscribed, and the development of malignant change is exceedingly unlikely; indeed, most authorities deny that it occurs.

The tumor described here must presumably have arisen in relation to peripheral filaments of the lingual or hypoglossal nerve. In this case it was solitary, and there was no evidence of any associated stigmata of neurofibromatosis.

I wish to express my gratitude to Dr. R. J. Sandry of the Pathology Department, Frenchay Hospital, for providing the histologic material and for his interest and help in the writing of this paper, and to Dr. A. Mayr-Harting of the Department of Preventive Medicine, University of Bristol, for her help with the German texts. My thanks are also due Mr. G. M. FitzGibbon and Mr. J. W. E. Snawdon for permission to publish this case, Mr. B. G. H. Levers for the photomicrographs, and Mr. F. A. Godman of the University of Bristol Medical Photographic Department for the clinical photographs.

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THE ORAL MANIFESTATION OF KERATOSIS FOLLICULARIS

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DARIER-WHITE'S disease, or keratosis follicularis, is a skin disorder that frequently manifests oral lesions. The degree of frequency with which both dermal and mucosal surfaces are involved appears to be one of conjecture, for no study has been made of this problem. Because we have noted oral involvement in several patients having extensive skin involvement, a short report was deemed worthwhile in order to bring this entity to the attention of the dental public.

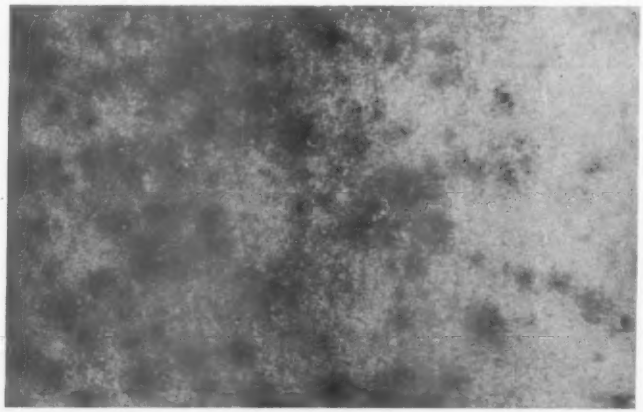

Fig. 1.—Keratosis follicularis. Photograph of skin of cervical area shows numerous papules, some of which are crusting. The papules are firm and singly arranged. Although initially erythematous, they characteristically ulcerate and become verrucous.

Clinically, the lesions may be present in two or more members of the same family, being inherited as an irregular dominant. They are manifest on the skin as small firm papules, singly arranged. They are of a reddish color when they first appear, but they characteristically crust, ulcerate, coalesce, and become verrucous and foul-smelling. They commonly present about the forehead and neck and over the shoulders (Fig. 1). The oral mucosa is probably more commonly involved than has been supposed. Other mucosal surfaces may be sites of the disease, for cases involving the vulva, pharynx, and larynx have

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been reported. Reenstierna,[1] in 1917, first reported oral manifestations. Other cases have been reported by Brünauer,[2] Frost,[3] and Harris and White.[4] Harris and White, however, reported "hypertrophic changes in the gums" in the case which they cited, but no biopsy was taken. In our opinion, it is highly dubious whether this change represents a facet of the disease.

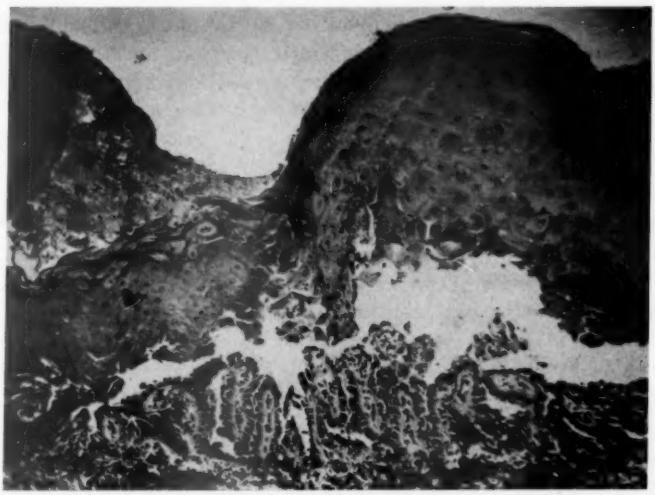

Fig. 2.—Keratosis follicularis. This section was obtained from the hard palate. The area was ordinarily covered by a full denture. Photomicrograph reveals suprabasilar vesicle. Corps ronds and lacunae are evident.

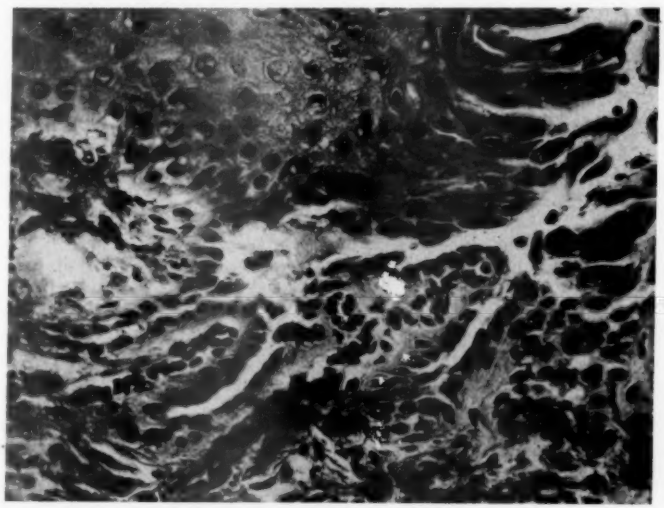

Fig. 3.—Keratosis follicularis. Higher-power photomicrograph of suprabasilar area demonstrates epithelial cells lining lacunae and "grains" within lumina.

Microscopically, keratosis follicularis is something of a misnomer. In no way are the changes restricted to the follicles, as is self-evident from mucosal involvement. Even on the skin this is by no means true. There are marked hyperkeratosis, papillomatosis, and acanthosis. However, the most characteristic or diagnostic features are the peculiar benign dyskeratosis and the lacunar formation.

The benign dyskeratosis is characterized by the presence of unusual cells—corps ronds and grains. Corps ronds are larger than normal squamous cells; they have round, homogeneous, basophilic nuclei and dark eosinophilic cytoplasm with a well-defined cell membrane. They are commonly seen in the upper stratum spinosum and stratum granulosum. The grains are small, elongated, parakeratotic cells seen in the stratum corneum. Both corps ronds and grains represent unusual partially keratinized cells, and both are also found in the lacunae or splitlike intraepidermal vesicles which are present directly above the basal layer (Figs. 2 and 3).

On the oral mucosa the disease is manifest by minute, whitish papules which feel rough to the palpating finger. Microscopically, the picture is virtually identical to that observed on the skin, except for the hyperkeratotic changes which are either mild or absent. Most commonly the gingiva, hard palate, and soft palate are involved. The lips and buccal mucosa have been spared in all cases seen by us.

Therapy is usually in the form of vitamin A.[5] Variable results have been obtained.

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ENDODONTICS

The American Association of Endodontists

Captain Warren J. Hedman, Editor

REGENERATION OF THE PERIODONTIUM AFTER ENDODONTIC THERAPY AND FLAP OPERATION

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REGENERATION of the periapical periodontium after endodontic therapy is well known. Regeneration is known to take place after conservative as well as surgical procedures, such as apicoectomy or periapical curettage.

In periodontal disease the formation of deep pockets occurs, beginning at the gingival margin and extending in an apical direction. In periodontal therapy such deep pockets may be eliminated by surgical means or by reattachment procedures. These methods have been studied and reported repeatedly. The healing of such defects of the periodontium is well known.

The present report deals with regeneration of the lateral aspect of the periodontium. In periapical disease a deep periodontal pocket might develop by an inflammatory process starting at the apex of a tooth, extending to the marginal area of the periodontium, and completely destroying the periodontal attachment. Bone, periodontal ligament, and gingival attachment are destroyed by such a process, leading to the formation of a deep pocket. Such a pocket is continuous from the periapical area to the oral cavity, opening into the gingival crevice. Thus, drainage of the periapical area has been achieved via a fistulous opening into the marginal periodontium.

MATERIALS AND METHODS

During the past three years, twenty cases of this type have been treated and followed for a minimum of one year. A favorable response was obtained in each case. Other cases were treated but could not be observed long enough for a final conclusion to be drawn. The ages of the patients ranged from 8 years to 72 years. Although the duration of these lesions could not be determined, some patients had complained of periodic swelling and drainage in the involved

area for more than one year. Clinical examination revealed the communication of the periapical with the marginal periodontium.

A typical case is that of a 16-year-old boy. The original diagnosis was made by an orthodontist. It can be assumed that necrosis of the pulp occurred in the mandibular right central incisor as a result of the deep carious lesions in the tooth. No traumatic history could be obtained, and there were no subjective symptoms.

Figs. 1 and 2 show an explorer at the gingival margin and after advancing to the periapical region.

Fig. 1.

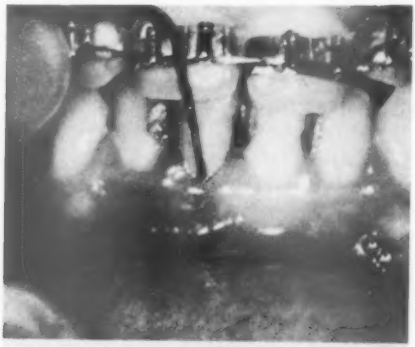

Fig. 2.

Fig. 1.—Probe at the marginal gingiva of a mandibular central incisor in a 16-year-old patient.

Fig. 2.—Insertion of probe to the apical region.

This case was treated by opening into the pulp chamber, widening the root canal with files, and irrigation with a sodium hypochlorite solution. The root canal was filled with a zinc oxide-eugenol paste and a gutta-percha point. A mucoperiosteal flap was retracted from the gingival margin by means of a vertical incision at either end of the flap (Fig. 3); thus, access to the periapical area was obtained. The periapical tissues as well as the lateral tissues were curetted, the pocket side of the flap was scraped with a curette, and the root

surface was planed thoroughly. The flap was replaced and sutured interproximally as well as at the site of the vertical incisions.*

One 25 mg. tablet of promethazine hydrochloride was given one hour before surgery, and a second tablet was given on retiring the same night. Each patient received 25 mg. cortisone acetate intramuscularly one hour before surgery.† Analgesic medication was restricted to tablets containing acetylsalicylic acid, caffeine, acetophenetidine, and codeine phosphate.

Fig. 3.

Fig. 4.

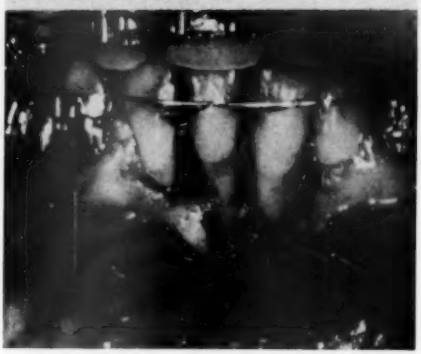

Fig. 3.—Retraction of mucoperiosteal flap from the gingival margin, showing complete loss of marginal and apical periodontium of the case shown in Fig. 1.

Fig. 4.—Retraction of mucoperiosteal flap after one year, showing regeneration of marginal bone. Approximately one-fourth of the labial aspect of the root is now covered with bone.

After one year a mucoperiosteal flap was again retracted (Fig. 4), showing regeneration of bone at the lateral aspect of the root. Approximately one-fourth of the labial aspect of the root was now covered with bone. Since the soft tissue attachment to the tooth was in the coronal third of the root, additional curettement was performed on the root and the flap in an effort to induce more bone regeneration.

*Previously, horizontal incisions resulted in severe recession at the gingival margin.

†Hiatt, William H.: Choice of Anti-inflammatory Agents in Root Resection, to be published in ORAL SURG., ORAL MED. & ORAL PATH.

The roentgenograms (Figs. 5 and 6) show this case at the time of operation and one year later. Considerable bone formation has taken place in the affected area. In the roentgenogram taken one year postoperatively the lamina dura is seen surrounding the root except at the apex, which appears to have resorbed slightly. The gutta-percha point, which formerly ended at the apical foramen (Fig. 5) now extends beyond the end of the root (Fig. 6).

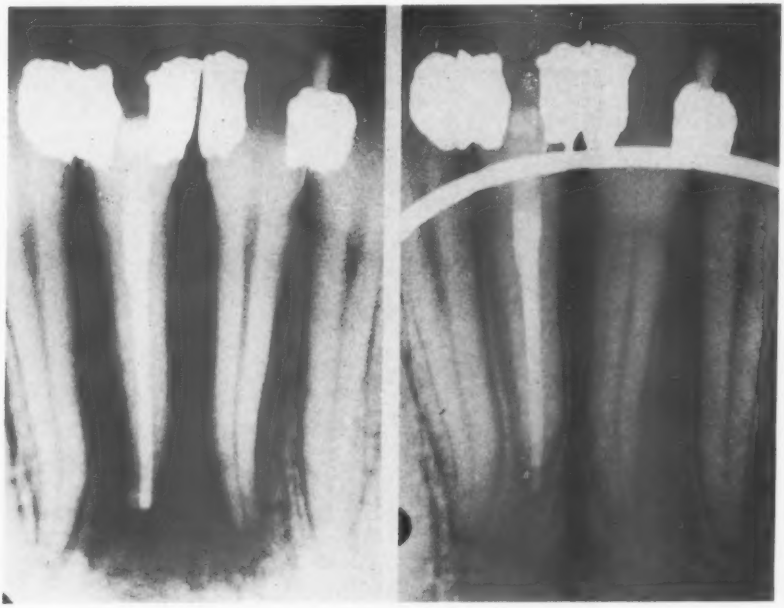

Fig. 5. Fig. 6.

Fig. 5.—Roentgenogram following root canal filling of case shown in previous illustration at the time of surgery.

Fig. 6.—Roentgenogram of previous case one year after operation. By comparing Figs. 5 and 6, one can observe effects of resorption at the apex.

A second case is that of an 11-year-old boy. Necrosis of the pulp in the mandibular central and lateral incisors, as well as the mandibular canine resulted from a blow. Probing revealed evidence of a fistulous communication between the gingival margin and the apical area of the canine. The three teeth were treated at the same time according to the methods described in the first case. Retraction of the mucoperiosteal flap (Fig. 7) revealed complete loss of bone, periodontal ligament, and gingival attachment on the labial and mesial surfaces of the canine. Fig. 8 shows the suturing at the site of the vertical and interproximal incisions. Retraction of a mucoperiosteal flap after one year (Fig. 9) shows regeneration of bone at the lateral aspect of the root. Approximately three-fourths of the labial aspect of the root is now covered with bone. Curettement was performed on the root and the flap in an effort to induce more bone regeneration.

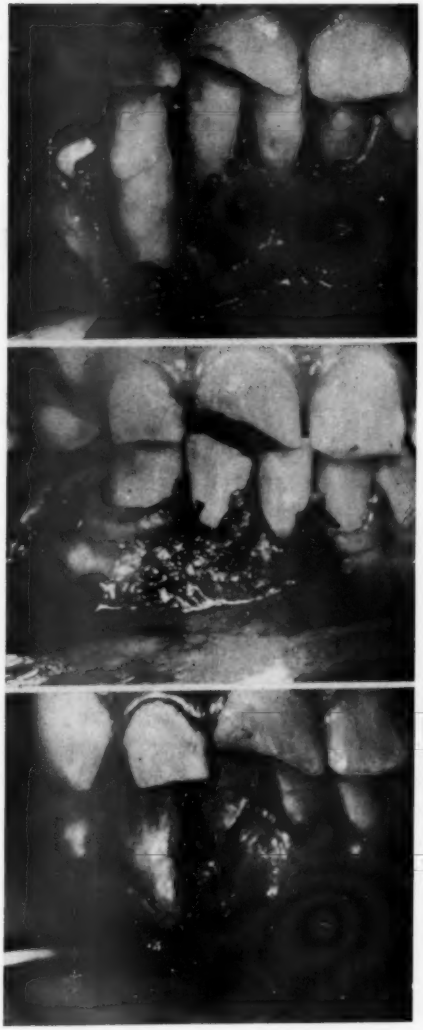

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 7.—Retraction of mucoperiosteal flap from the gingival margin revealed loss of marginal and apical periodontium around mandibular right canine of an 11-year-old patient. The bone was intact around the central and lateral incisors, which were also treated.

Fig. 8.—Suturing the flap in the case shown in Fig. 7.

Fig. 9.—Retraction of mucoperiosteal flap after one year showing regeneration of marginal bone. Approximately three-fourths of the labial aspect of the root is now covered with bone.

The roentgenograms (Figs. 10 and 11) show this case at the time of operation and one year later. Considerable bone regeneration can be observed.

DISCUSSION

In all twenty cases there was evidence of a firm gingival attachment at the end of six weeks. Some bone formation could be seen in three months, with roentgenographic evidence of nearly complete bone and lamina dura formation appearing in one year.

Fig. 10. Fig. 11.

Fig. 10.—Roentgenogram at the time of surgery, after root canal filling, in case shown in Fig. 7.

Fig. 11.—Roentgenogram one year after surgery, showing considerable bone regeneration.

Some of these teeth were extremely mobile and had to be held firmly during the operative procedures to prevent accidental extraction. In no instance was an attempt made to immobilize a tooth by either temporary or permanent splinting, although there was no contraindication for splinting. All teeth were firm in six months.

In some of the twenty cases reported here, no attempt was made to scrape the inside of the flap, as is usually done in reattachment operations to assure removal of all the pocket epithelium. The present cases represented rather acute episodes of pocket formation, and it was assumed that no epithelization had taken place. Even though some of these cases may have been of long standing, purlent discharge and/or granulation tissue may have inhibited

growth of epithelium from the gingiva. This assumption was confirmed by the fact that the noncuretted cases healed as well as the curetted cases. The same can be said about planing the exposed root surfaces. In most instances no hard calcareous deposits were found on the root surfaces, and only moderate root planing seemed to be indicated.

The favorable clinical response of the connective tissue in the organization of the blood clot, with subsequent regeneration of the periodontium may be seen in the roentgenograms taken one year after surgery and in the surfaces exposed by a flap.

Probing the gingival crevices after six weeks and again after one year revealed 2 to 4 mm. pockets, whereas at the time of operation the depth of the pockets was 10 to 16 mm.

A search of the endodontic literature revealed no similar report dealing with this problem.

SUMMARY

Simultaneously, endodontic therapy and a flap operation were performed on twenty cases of destruction of the lateral periodontium arising from periapical lesions. In each case there was a fistulous communication between the apex of the tooth and the gingival margin. All cases responded favorably to this therapy, showing regeneration of the periodontium by clinical evidence. The age differential of the patients did not alter the healing time.

1325 E. 16TH AVE.

FOREIGN BODY IN THE ALVEOLAR BONE

Report of a Case

Ian W. Cameron, L.D.S., B.D.S., F.D.S.R.C.S., Bristol, England

CASE REPORT

On Nov. 1, 1956, a young woman, aged 18 years, was referred to Bristol Dental Hospital from the Bristol Eye Hospital. She was suffering from choroiditis of the right eye and had been referred for an opinion as to the possible presence of any dental foci of infection.

There were no dental symptoms, and on clinical examination the patient was found to have a good, well-cared-for dentition. She had a partial denture replacing the upper left central incisor which she stated had been extracted some eighteen months previously. The mucosa in this region was quite normal.

Roentgenographic examination revealed the presence of an opaque body, apparently in the alveolar bone, in the region of the missing upper left central incisor (Fig. 1). It was partly surrounded by a small, well-delineated, radiolucent area. From its shape and radiopacity, the foreign body was thought to be either a root filling or a crown post. The roentgenogram also revealed the almost complete obliteration of the pulp chamber and root canal of the upper left lateral incisor with calcific material. This tooth was not discolored. No response to hot or cold stimuli could be elicited from it.

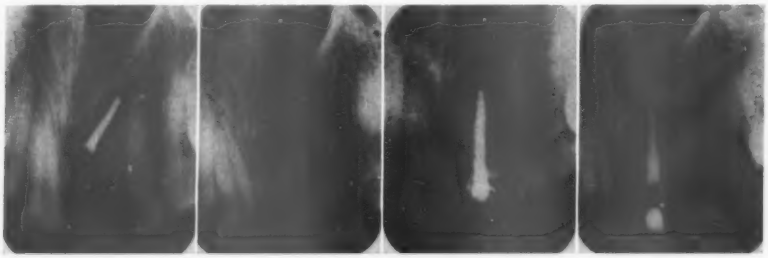

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Fig. 1.—Roentgenogram of upper left central incisor region showing foreign body and surrounding radiolucent area.

Fig. 2.—Roentgenogram of upper left central incisor region taken when patient was 16 years old.

Fig. 3.—Roentgenogram of upper left central incisor area immediately after the apicoectomy had been performed.

Fig. 4.—Roentgenogram of upper left central incisor showing root canal filling forced beyond apex.

The patient's private practitioner was consulted and was able to provide a history of her previous treatment, together with a series of roentgenograms which made it possible to reconstruct the development of this unusual lesion.

History.—At the age of approximately 7 years the patient had been knocked down by a bicycle, and the crown of the upper left central incisor had been fractured without exposure of the pulp. While there had been no symptoms, the tooth had slowly become discolored.

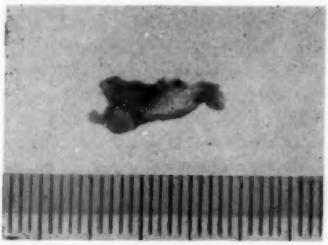

Fig. 5.—The specimen on removal. (Scale in millimeters.)

Fig. 6.—A longitudinal ground section of the upper left lateral incisor. (Magnification ×8; reduced ¼.)

When the practitioner first saw the patient (in June, 1954) she was 16 years old and this discoloration was noted. A roentgenogram (Fig. 2) taken at that time showed that there was a large area of apical rarefaction in relation to this tooth and that its apex was still

open. The formation of the root was incomplete, whereas the root of the upper right central incisor was fully formed. This roentgenogram also showed evidence of calcification within the pulp chamber and root canal of the upper left lateral incisor.

In the light of this evidence, the patient's dental surgeon decided to attempt root canal therapy followed by root canal filling and apicoectomy of the upper left central incisor. One month later he carried out this treatment, using a gutta-percha point and a zinc oxide and oil of cloves paste as a root canal filling. The apicoectomy was performed three days after the insertion of the root canal filling, and the apical area was found to contain some fluid. A cystlike lining was removed but was not subjected to histologic examination. Fig. 3 shows the roentgenographic appearance at this time. Healing was uneventful and six months later, in March, 1955, the tooth was prepared to receive a post crown restoration. Four days after this preparation, however, the patient returned complaining of considerable pain in relation to this tooth. A roentgenogram (Fig. 4) showed that the fitting of the crown post had forced the gutta-percha point used as a root filling through the open apex.

Fig. 7.—Higher-power view of pulpal area showing system of empty branching "tubes." (Magnification, ×40; reduced 9/10.)

It was then decided that the left central incisor should be extracted. This procedure was carried out under general anesthesia five days later. Healing was uneventful, and a partial denture was fitted.

From this history, it was thought that the opaque foreign body was the gutta-percha point used as a root canal filling, which had been forced through the apex and had now been retained following the extraction of the upper left central incisor.

Surgical exploration of the area under local anesthesia proved this to be correct. A fibrocystic follicle was removed within which was a gutta-percha point (Fig. 5). On histologic examination of the specimen, a stratified squamous epithelial lining was evident within the fibrous sac.

Because the roentgenogram showed a lack of continuity of the lamina dura around the apical region of the root of the upper left lateral incisor, this tooth was also removed. A ground section of this tooth (Fig. 6) showed the enamel to be normal with considerable incisal attrition, and the configuration of the primary dentine shows that the apex was wide open prior to the calcific changes in the pulpal tissues. This dentine shows numerous interglobular spaces.

There is a marked deposition of tubular secondary dentine on the apical half of the pulpal surface extending beyond the original length of the primary dentine root. This dentine shows many interglobular spaces. There is a deposition of acellular and, in places, also of cellular cementum over the complete root surface.

Fig. 8.—Higher-power view of termination of one of the "tubes" in the secondary dentine, showing evidence of resorption and subsequent deposition of cementum-like tissue. (Magnification, ×150; reduced 3/10.)

The pulpal tissues have been replaced almost entirely by calcified repair tissue resembling primitive bone similar to that described by Fish.[3] This is permeated by a system of empty branching "tubes," some of its peripheral elements running into the secondary dentine which shows evidence of resorption in the form of lacunae, both on its pulpal surface and in relation to the branching "tubes," especially their terminations in its substance (Figs. 7 and 8).

DISCUSSION

Foreign bodies in and about the jaws have been reported by a number of authors. Most of these foreign bodies have been in the soft tissues, and if we exclude serious traumatic injuries, such as gunshot wounds, the most frequent foreign bodies are probably small pieces of amalgam, broken hypodermic needles, and radiopaque solutions. Winter[8] reports the presence of a gold inlay in the soft tissues in the lower buccal sulcus and of an emery stone in the floor of the mouth. Archer[1] describes a fissure burr embedded in the soft tissues.

Intrabony inclusion of foreign bodies seems to be comparatively rare. Again excluding cases due to severe trauma, the most common risks would appear to be those of filling materials falling into recent extraction sockets or cystic cavities and of the overfilling of root canals with extension of the root filling material beyond the apex. Castagnola and Orlay[2] report a number of cases in which root filling material was introduced into the maxillary antrum and one case in which root filling material was forced into the inferior dental canal, producing a temporary paresthesia.

Jeffrey[4] and Lane[5] both report cystic cavities containing amalgam, and Archer[1] shows roentgenograms of a cyst containing what appear to be several pieces of radiopaque filling material. Tratman[7] reports a short length of silk thread associated with what appeared to be some oxyphosphate cement within a cyst cavity. Although several of these authors state or imply that the cyst formation is a result of the presence of foreign material, in none of these cases (nor in the present one) is it necessary to invoke such a mechanism, as it seems much more probable that a cyst was already present and that the material has found its way into the cavity. This is not to deny that irritation caused by the foreign material may be a contributory factor in the further growth of the lesion.

The present case would seem to be a hitherto undescribed complication of the difficult and as yet unsatisfactorily solved problem of root filling in a tooth with an open apex. The fact that this lesion was completely symptomless and clinically undetectable illustrates the importance of a complete roentgenographic examination in the search for foci of infection and indicates that edentulous areas should be included in the roentgenographic survey.

It is interesting to compare the reactions to traumatic injury of the upper left central and lateral incisors. It is impossible to discover whether the original trauma was more severe to the one than to the other, since neither root was complete at the time of the injury, although at this age one would expect the development of the central incisor root to be the more advanced of the two. In this case, however, the pulp of the central incisor did not survive, while that of the lateral incisor did. The histologic appearances seen in the lateral incisor are very similar to those which Rushton[6] has attributed to the late results of injury. It is very probable that the trauma temporarily interrupted the blood supply. When this was re-established, the younger, more apical parts of the pulp formed tubular dentine once again and completed the formation of the root. The older, more coronal parts, on the other hand, formed chiefly a more

irregular calcified matrix. The blood vessels have reserved themselves space in this calcified matrix in the form of the branching "tubes." It would appear that at some later date there has been some resorption in relation to these areas.

SUMMARY

A case in which a root canal filling was found in a cystic area, the root canal filling having been retained following the extraction of an upper central incisor with an open apex, has been reported. The lateral incisor showed calcific changes in the pulp as a late result of the same trauma which had caused the death of the pulp of the central incisor.

I should like to express my thanks to Mr. W. Scawin, L.D.S., of Patchway, Bristol, for providing me with the history and radiographs of his patient. I am also indebted to Professor M. A. Rushton for his advice on the histologic material and to Professors A. I. Darling and E. W. Bradford for their help in the preparation of this paper. I also wish to thank Mr. B. G. H. Levers for the photomicrographs and Mr. F. A. Godman of the University of Bristol Medical Photographic Department for the other illustrations.

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RESEARCH

STRUCTURAL CYTOLOGY OF THE HEALING WOUND

I. The Fibroblast

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PRELIMINARY INTRODUCTION

THE mechanism of wound healing has been studied at length. Adequate summaries of early investigations are given by Marchand[30] and Arey,[2] and a more recent one is presented by Howes.[25] These summaries include few papers on the intimate structure of the cellular elements which comprise the healing wound. It appears that further knowledge of these basic elements would afford a clearer understanding of their role in regenerative processes.

The cells that can be identified in the healing wound are fibroblasts, lymphocytes, histiocytes, plasma cells, neutrophilic leukocytes, and fat cells. The presence of other leukocytes and erythrocytes may be incident to complication and prolonged inflammation. Fibrils and other noncellular elements are associated also with wound repair. The microscopic structures of these cells and associated elements have been elaborated in fixed preparations, in tissue culture, and in vivo from mature and embryonic connective tissue. Their association with epithelization and fibroplasia has been recognized; however, little information has been offered to indicate a similarity of these cellular elements to their counterparts from loose connective tissue. This article is the first of a series which will treat individually the cell types that comprise the healing wound.

DENTAL EXTRACTION WOUNDS

Healing of uncomplicated and complicated dental extraction wounds has been studied in rats,[6, 16, 26] dogs,[4, 14, 47] sheep,[18] and man.[10, 29, 46] These studies reveal that the healing pattern of dental extraction wounds is like that of other wounds. The traumatic inflammatory or exudative phase is followed by the

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migration inward of mononuclear cells or fibroblasts and the formation of a cicatrix. Internally, collagen fibers are deposited and cellular development and differentiation are continued. Healing in the alveolar socket is accompanied by ossification, first from the fundus of the socket and then medially between the buccal and lingual crests,[26] so that the ultimate "fill" contains osseous as well as connective tissue elements.

SOURCE MATERIAL

The source material for the present study was a twenty-four-day postextraction fibroplasia from a human alveolar socket (Fig. 1). The wound was complicated by the fact that a root fragment had not been removed when the tooth was extracted and, though repair proceeded, surgical removal of the fragment was deemed necessary. Histologic examination of the excised tissue revealed both normally developing fibroplasia beneath a wet epithelization and a foreign body reaction in a restricted area of the fundal extension. The course of repair and of a progressive age development series was seen from the periphery centrad. This afforded an opportunity to study in one specimen progressive cellular age changes in normal and inflamed tissue.

PROCEDURE

The fibroplasia was fixed immediately in 2 per cent buffered osmium tetroxide[37] for three hours, rinsed, and dehydrated to absolute alcohol. Select portions were removed and embedded in methacrylate.[36] Sections of $\frac{1}{40}$ micron or less were examined with the RCA EMU-2 electron microscope and low-power electron microscopy. The remainder of the fibroplasia was taken from absolute alcohol through benzene to paraffin embedding. Sections measuring 3 to 5 microns were taken; some were examined unstained with phase microscopic attachments, and others were bleached in 6 per cent hydrogen peroxide and stained cytologically for regular light microscopy.

The Fibroblast

INTRODUCTION

The structure of the connective tissue fibroblast was elaborated early.[31] Whether such a fibroblast is homologously analogous to the fibroblast of the healing wound is not known. It is elongated, flattened, and usually situated alongside bundles of fibers. The nucleus is large, oval, and flattened, with a delicate nuclear membrane and a small amount of finely divided chromatin.[8] Sometimes a small nucleolus is present. The cytoplasm is pale, almost homogeneous, ordinarily without granules, and sometimes vacuolated.[8] The mitochondria appear as slender rods which are scarce in the processes but more numerous near the nucleus and around the cytocentrum.[32, 39] The cytoplasm of the resting fibroblast rarely contains inclusions except for occasional small fat droplets.[32]

The fibroblast derives its name from the belief that it produces intercellular fibers. Proponents of the intracellular fibrogenesis concepts believe the fibers

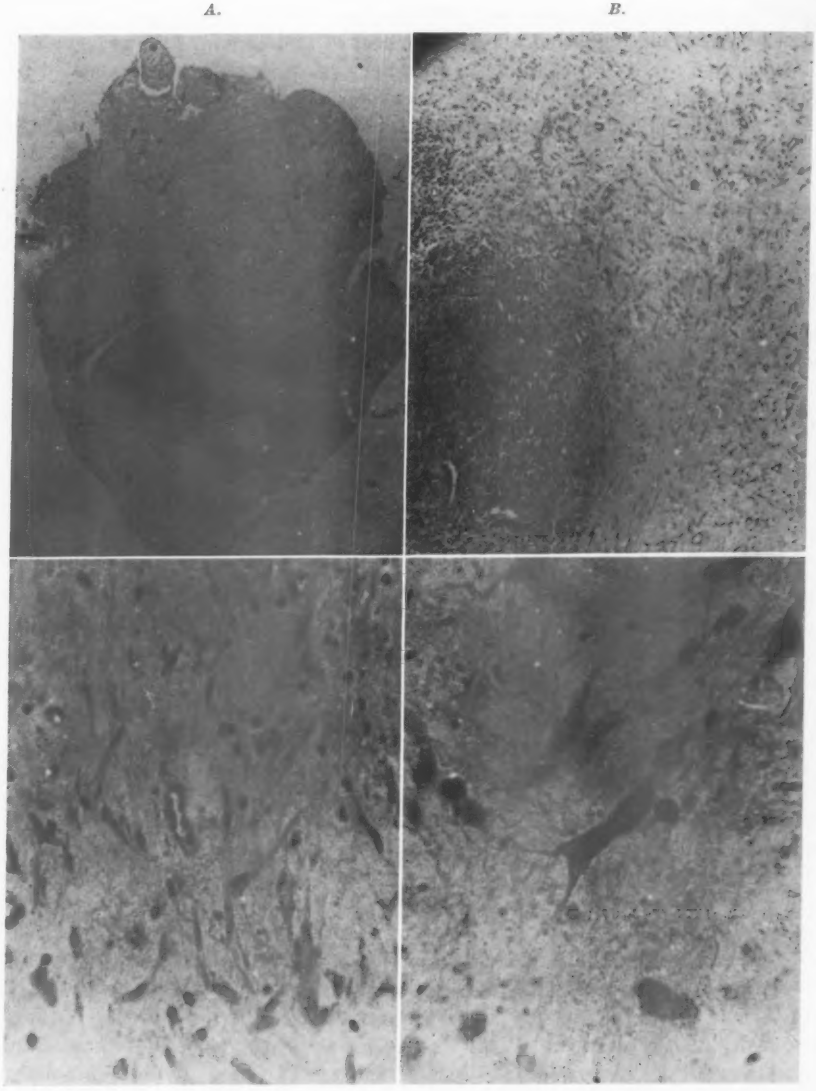

Fig. 1.—Photomicroscopic enlargement of the excised tooth extraction wound. The specimen was fixed in 2 per cent osmium tetroxide, bleached in 6 per cent hydrogen peroxide, and stained with methyl-green-pyronine. (Optics by Bausch & Lomb.)

A, Cross section of the fibroplasia section near the fundal extension. (Magnification, ×42; reduced ⅓.)

B, Enlargement of same section showing the edge of the area of inflammation. (Magnification, ×125; reduced ⅓.)

C, Further enlargement showing fibroblasts, mononuclear cells, and capillaries. (Magnification, ×450; reduced ⅓.)

D, The fibroblast body outline as depicted classically. (Magnification, ×1000; reduced ⅓.)

to be formed intracellularly or upon the cell surface and extruded into the intercellular substance where they "grow."[15, 20, 28, 44] It was even suggested that mitochondria were the starting material for intercellular fibers.[33] The intercellular fibrogenesis school proposed that the fibers are formed from elements present in the intercellular substance in response to fibrocytic and other enzymes.[19, 21, 31, 40] The studies of Wohlbach[48] and Porter[39] appear to support this view. Since vitamin C deficiency inhibits the development of intercellular fibers but not fibroblast growth,[5, 7, 27] it would seem that there are factors within the ground substance which are essential to fibrogenesis.

Carrel and Ebeling[9] have demonstrated in tissue cultures the production of both fibroblasts and macrophages from monocytes. Similar findings with intermediate steps have been observed by Moen.[34] Ebert and Florey[12] demonstrated the transformation of migrated mononuclear blood cells into perivascular spindle cells; Robertson[42] stated that fibrocytes arose from capillaries and histiocytes. In essence, their individual observations, which are mutually complementary, are substantiated and extended by Allgower,[1] who postulated generally that blood itself is basically responsible for wound repair in that the round cells are blood elements which under appropriate stimulation develop into fibrocytes.

The fibroblast has been implicated as the primary element in wound repair.[17] Attention has been called, however, to the role of capillary sprouting[22, 41] and endothelial proliferation.[43] It has been implied that during inflammatory processes fibroblasts develop into granular leukocytes, but there is no evidence for this. There is evidence that they may develop into macrophages,[32] but this transformation is denied by most investigators.

DESCRIPTION

A developmental series of fibroblasts was seen. In order of development, they are referred to as prefibroblast, young fibroblast, intermediate fibroblast, and advanced fibroblast.

The advanced fibroblast had no homogeneously consistent form. It was elongated in longitudinal section or stellate in tangential or cross section (Fig. 2). The plasmalemma was distinct, but it was frequently indented with *b*-cytomembranes extending into the cytoplasm. Some of these membranes seemed to be continuous into the cytoplasm of adjoining cells where there existed syncytial connections (Fig. 5, *A*). It has been impossible to demonstrate a continuity of the *b*-cytomembranes with the associated collagen fibers.

The nuclei of advanced cells were irregularly oval and flattened, and they extended in the direction in which the cell body was flattened and extended. Nuclei of intermediate cells were almost spherical. There was a pronounced irregularity of the nuclei of young fibroblasts from the area of inflammation. The severe constriction of some of these nuclei makes necessary a consideration of nuclear fragmentation. Chromatin was fine and homogeneously distributed within the nuclear membrane except in instances in which it appeared to be in mitotic organization (Fig. 2, *C*).

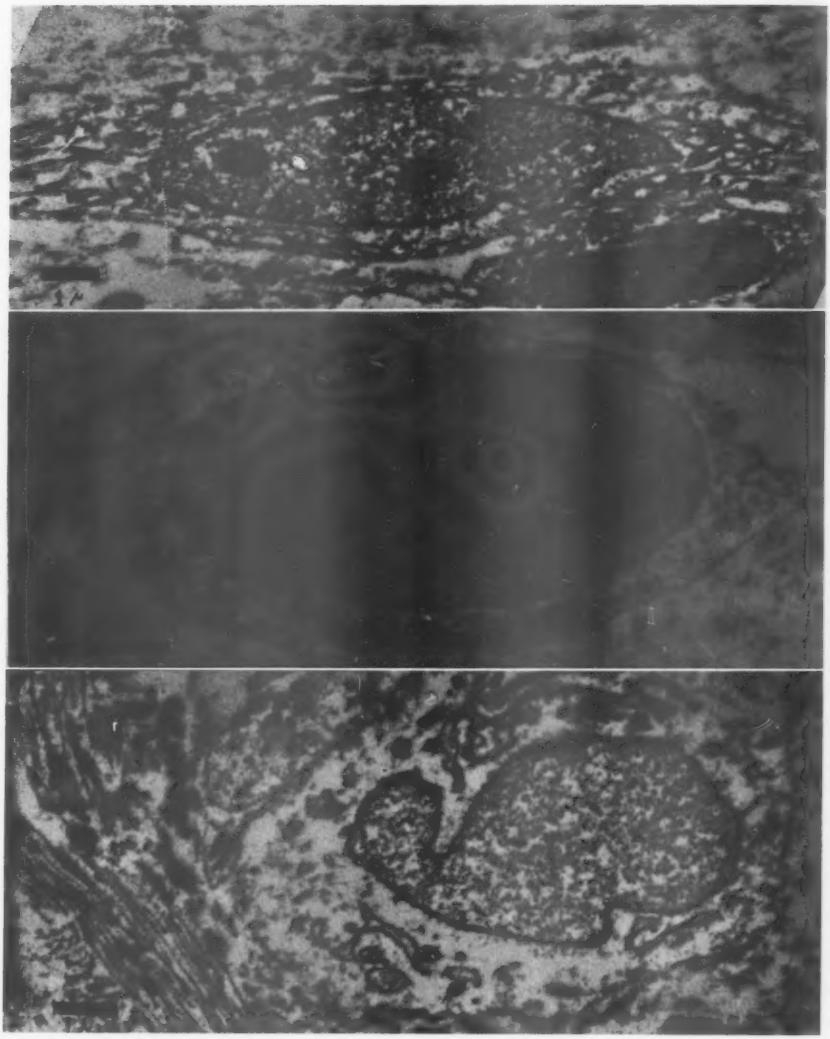

Fig. 2.—The fibroblast body.

A, The advanced fibroblast body in longitudinal section. The immense nucleus and nucleoli are readily obvious. Within the cytoplasm are seen elongated mitochondria and cytoplasmic membranes. (Magnification, ×14,000; reduced ⅓.)

B, The advanced fibroblast in cross section. A mitochondrion above and several mitochondria below the nucleus show internal structure. Fine structure of mitochondria may be seen in Fig. 5, *B*. (Magnification, ×27,000; reduced ⅓.)

C, The young fibroblast in cross section. Note irregularity of nucleus and syncytial connections with adjoining cells. Fiber bundle width, 1.2 microns. Fiber width, 57 A. (Magnification, ×15,000; reduced ⅓.)

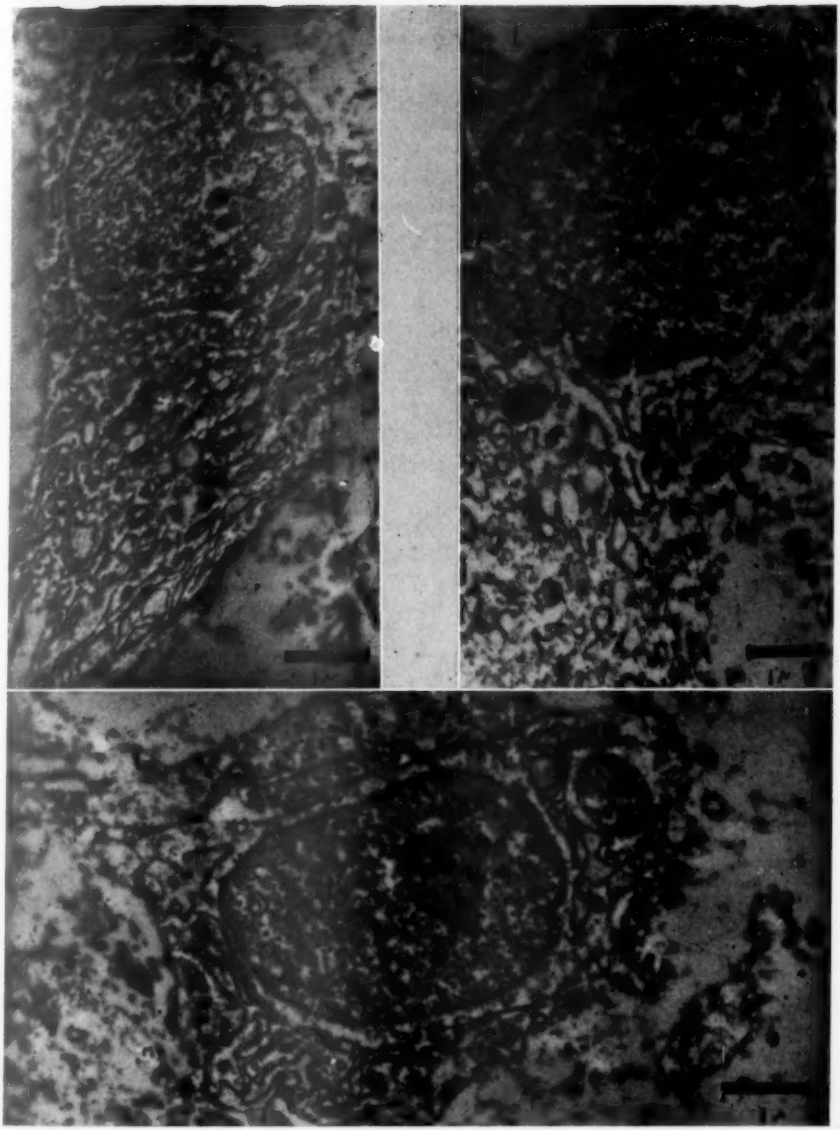

Fig. 3.—Comparison of an intermediate fibroblast with an endothelial cell.

A, An intermediate fibroblast with extreme vacuolation resembling the *b*-cytomembrane system of Sjostrand. (Magnification, ×19,000; reduced ⅓.)

B, An endothelial cell lining a capillary. The lumen (*L*) of the capillary is seen in the upper left-hand corner. Nuclear and cytoplasmic configuration is similar to that of the intermediate fibroblast. (Magnification, ×18,000; reduced ⅓.)

C, An intermediate fibroblast showing greater organization of the tubuli system and less vacuolization. The tubuli sometimes terminate as lacunae. (Magnification, ×22,000; reduced ⅓.)

The nuclear membrane was double, with a less osmiophilic interspace. Attention could be given to the possibility that the external nuclear membrane is actually the internal cytoplasmic membrane. Nucleoli were present, but they were not clearly apparent in all instances.

Cytoplasm of advanced cells was diffuse and contained fat droplets, vesicles, and other osmiophilic components. All mitochondria had an internal structure (Fig. 5, *C*). Young cells from the granulation depth were intensely infiltrated with tubuli, the whole resembling generally the *a*-cytomembrane system of Sjostrand.[45]

Whereas in some areas there was a regularity in spacing of the restricting membranes, there were other areas in which the tubuli enlarged to form irregular lacunae. Mitochondria and other internal structures were not apparent in the cytoplasm of these cells due to the prolific penetration of the tubuli (Fig. 3).

Collagen fibers were observed intercellularly in close contact with the fibroblasts, but a study of their positional association did not establish an obvious relationship with the fibroblasts.

A study of nuclear morphology revealed a possible route for development of fibroblasts. Mononuclear cells (prefibroblasts) with characteristic nuclei and a thin halo of cytoplasm were observed sometimes adjacent to other mononuclear cells with a larger halo. Some of these prefibroblasts and young fibroblasts showed intense vacuolization and infiltration by tubuli. After further development these young fibroblasts showed less vacuolization, and at maturity the cytoplasm was evenly diffuse (Fig. 4).

DISCUSSION

Histologically, the healing pattern of the dental extraction wound is the same as that of other types of wounds except that osteogenic elements invade the alveolar socket in about six to ten days.[10] The present fibroplasia was excised in such a way that it did not include these elements.

There appear to be differences in the developmental patterns between the connective tissue fibroblasts and the fibroblasts of the healing wound. Whereas the mature fibroblast of the healing wound resembles that of connective tissue, the young fibroblast of the healing wound appears to have no counterpart in normal connective tissue. This may be explained by the fact that the fibroblast of connective tissue is reproduced mitotically whereas the wound fibroblast is generated from an undifferentiated cell. Most apparent in the young fibroblast of the healing wound is the disposition of the cytoplasm and associated membranes enclosing tubuli within the cytosome. There is a marked resemblance of the whole to the *b*-cytomembrane systems of Sjostrand.[45] There are many instances, however, in which the tubuli-enclosing membranes are not paired equidistantly for their entire length but diverge to form irregular lacunae (Fig. 3, *C*). The entire system of membranes, tubuli, and lacunae presents a spongelike appearance generally; however, the *b*-membranes are not continuous as fibers. As there appears to be no logical reason for the creation of greater

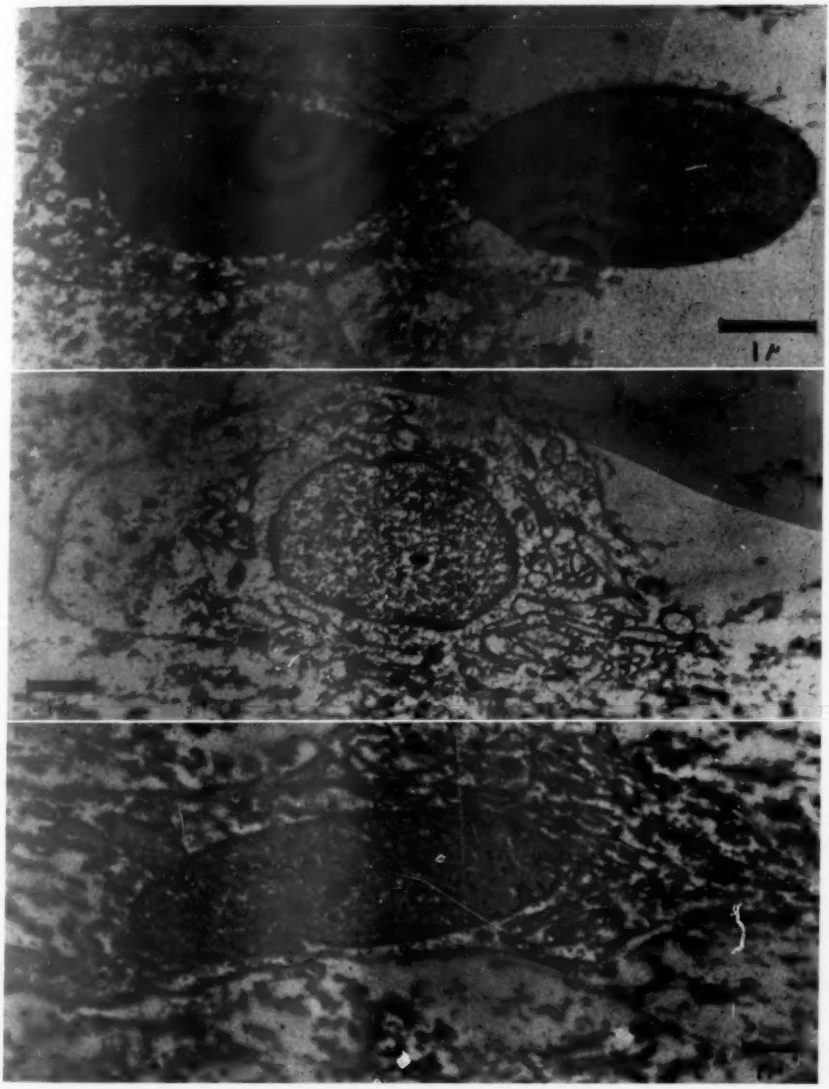

Fig. 4.—Plate showing a route of fibroblast development.

A, Prefibroblast. Note mononuclear cells with lesser and greater halos of cytoplasm. The cell to the right shows indications of cytoplasmic vacuolation. The immediate limits of the cell adjoin the surrounding clot. The young fibroblast may be seen in Fig. 1, *C*. (Magnification, ×22,500; reduced ⅓.)

B, Intermediate fibroblast. Cytoplasmic development has continued, and an increase in vacuolation is noted. (Magnification, ×15,500; reduced ⅓.)

C, Advanced fibroblast. The advanced fibroblast shows a more elongated nucleus and a denser and less vacuolated cytoplasm than the intermediate forms. The mature fibroblast (Fig. 1, *A* and *B*) shows homogenous cytoplasm and evenly diffuse chromatin. (Magnification, ×12,500; reduced ⅓.)

absorptive surface, it would be logical to assume that in addition to wound contraction,[23] certain internal elements of the wound expand to hasten the eventual closure. This expansion, though supported by fibers and other cellular elements, is of a delicate "framework" nature. Subsequent proliferations and maturations result in a less vacuolated cytoplasm; in time the decrease in vacuolation parallels the increase in tensile strength.

Attention may be called to the nature of the nuclei of the young fibroblasts within the granulation depth. On previous occasions, attention has been focused on the possibility that fibroblasts may reproduce amitotically. The constricted nature of some of the young fibroblasts would give such an impression. The question arises also as to whether or not these young cells can be called fibroblasts since in their young form they vary morphologically from the advanced cell, which has been demonstrated to divide mitotically. Unfortunately, there is little irrefutable knowledge on the origin of fibroblasts, and there is even less on the transitional stages through which they pass until they are structurally recognized as fibroblasts. It is apparent that, in actuality, a study of young fibroblasts may be a study of primitive polypotential cells with reproductive characteristics dissimilar to those of advanced cells.

Morphologic characteristics of young fibroblasts are observed also in certain types of endothelial cells lining capillaries. This might indicate that fibroblasts develop from endothelial or perivascular cells[42] which had been derived from monocytes.[12] Allgower[1] and Moen[34] have postulated a development of fibroblasts directly from monocytes; Ebert and Florey[13] have shown the development of histiocytes from monocytes. In view of the primitive nature of these cells morphologically, we cannot deny the possibility that monocytes may develop into fibroblasts, endothelial cells, and histiocytes, either directly or with intermediate phases.

It was not possible to demonstrate a specific relationship between collagen fibers and classically depicted fibroblasts. Fibers were seen more readily in association with another distinct cell type differing morphologically from the classically depicted fibroblast (Fig. 5, *C*). It is proposed that this cell type be called "fibrocyte" since present usage favors the retention of the term "fibroblast" for the cells herein previously described. A study of the relationship between "fibrocytes" and fibers is presently in progress.

More intercellular submicroscopic fibers were in the granulation depth than in the advanced healing areas where coarser fibers were observed in whorls and other configurations. This might imply that during the exudative phase of wound healing a submicroscopic fibrillar network is formed within the "fill,"[39] followed by the entrapment and differentiation of the primitive cellular elements.

Quite remarkably the gross morphology of the fibroblast has been elaborated well by light microscopists. The fine structure of the intracellular components in the advanced cell has been described from other material. A morphologic study is limited, since from observed morphology one must conjecture upon physiologic function. It is seen that knowledge can be made available in this manner, but it is seen also that corollary physiologic investigations must be undertaken in order that the role of the fibroblast in the healing of extraction wounds and other wounds might be correctly determined.

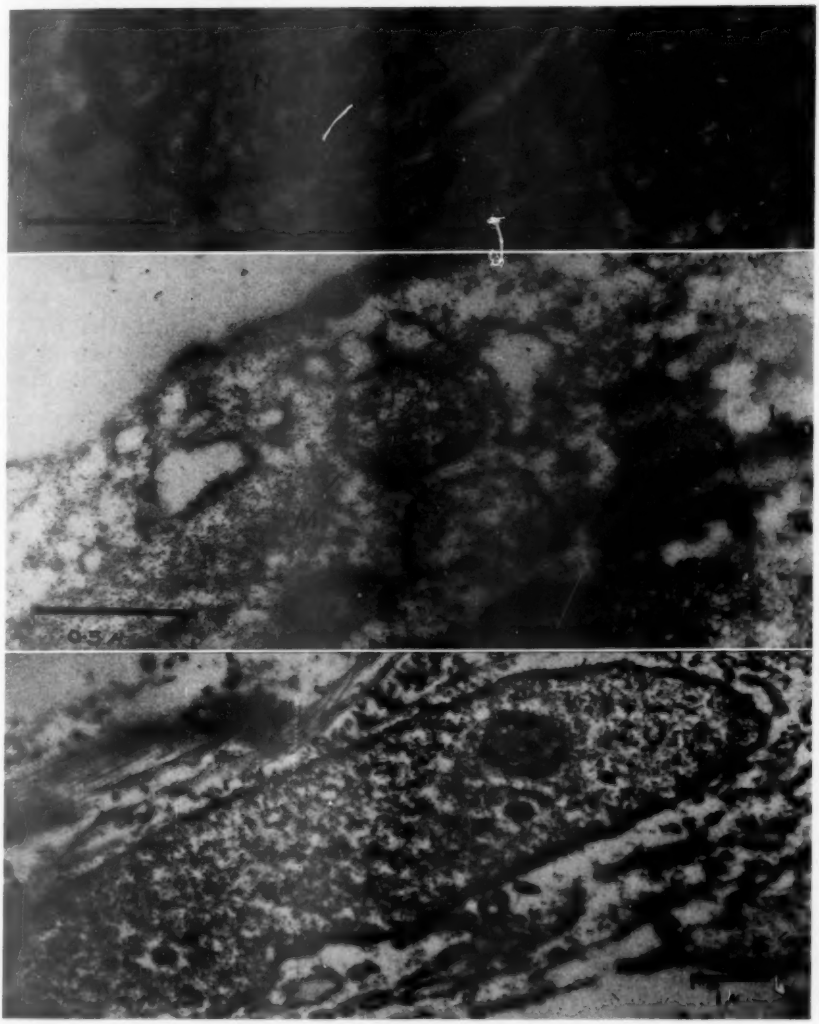

Fig. 5.—*A*, Syncytial cellular connections in an intermediate fibroblast showing the preponderance of *b*-cytomembranes to cytoplasm of adjoining cell. *N*, Nucleus. Membrane composite. 290 Å; intermembranous space, 174 Å; osmiophilic membranes, 58 Å. (Magnification, ×33,000; reduced ⅓.)

B, Mitochondria from an advanced fibroblast. The internal structure appears as indistinct ridges within a homogenous matrix. *N*, Nucleus; *M*, mitochondrion. Mitochondrial membrane thickness, 210 Å; average mitochondrial diameter (100 measurements), 0.4 micron. (Magnification, ×70,000; reduced ⅓.)

C, A "fibrocyte" with elongated nucleus similar to fibroblast. Collagen fibers are seen within the cytoplasm, seemingly arising from the proximity of the nucleus. The nuclear membrane is double and may be seen at intervals; the heavy deposition of oxides of osmium obscures the tracing of this double membrane for its entirety. (Magnification, ×18,000; reduced ⅓.)

SUMMARY

A morphologic study of the fibroblasts of a healing tooth extraction wound has been made by means of light microscopy and low-power electron microscopy. The knowledge gained with respect to the advanced fibroblast is confirmatory. The young fibroblast differs morphologically from the newly divided cell in normal connective tissue; there are characteristics indicative of primitive undifferentiated cells. Similarities were noticed between the young fibroblast of the healing wound and certain endothelial cells of associated capillaries. Extensive tubule systems within the cytoplasm of young fibroblasts formed sponge-like networks. Such cellular networks are believed to hasten wound filling through expansion from within as cells surrounding the wound promote closure from without.

Fibers were observed in a closer association with a cell type morphologically distinct from the classically depicted fibroblast. The proximity of the fibers to this "fibrocyte" necessitates a study of its role in fibrogenesis.

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Section by the

ARMED FORCES AND PUBLIC HEALTH SERVICE

PHYSIOLOGIC STUDIES IN GENERAL ANESTHESIA FOR AMBULATORY DENTAL PATIENTS

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A SURPRISINGLY large number of general anesthetics are given in dental offices in this country. In some cities it is estimated that almost as many patients are anesthetized in dental offices as in hospitals.[1] These anesthesias are administered to outpatients and are considerably different from the general anesthesias employed in the surgical procedures performed in the hospitals. The patients are ambulatory, often unpremedicated, anxious, and nervous, and they expect to be incapacitated for short periods of time only. The surgery is performed in the oral cavity, a part of the all-important airway, where blood and saliva, operative debris, and throat packs have to be seriously considered as potential hazards to the patency of the airway. For these and many other reasons, dental anesthesiology is a separate art and science and may be considered a subspecialty of anesthesiology.

Literally thousands of studies on the physiologic effects of general anesthetics on the human body have been made and reported. For the most part, however, because of the radical differences between general surgical anesthesia and general office dental anesthesia, the results of these studies are not applicable to dental anesthesia. Therefore, when the dental surgeon employs the office type of general anesthesia there is no storehouse of physiologic information to guide him in his efforts.

The first purpose of our study, then, was to gather pertinent information concerning the human physiology under the stress of general anesthesia and dental surgery.

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A second and equally important purpose was to establish base lines of physiologic performance of today's anesthetics for comparison with the newer and better drugs which are being synthesized.

Many different anesthetic agents could have been studied, but for our initial effort the intravenous barbiturates were chosen. In trained and experienced hands, they come close to being ideal agents for short operations, and in a large number of good-risk patients they can be used without premedication. The selection of single drugs for study, rather than a mixture of drugs, has distinct advantages since anesthetic mixtures present such a variety of actions, ranging from synergism to antagonism, that interpretation of data is difficult, if not impossible.

MATERIALS AND METHODS

The majority of the patients were healthy adult hospital employees, all of whom had had a physical examination and a chest x-ray within the preceding year. A complete history was obtained from those few patients who were not hospital employees, and those patients were given a physical examination. In addition, all patients were interviewed as to past medical history, and the following laboratory tests were performed: hemoglobin, white blood count, hematocrit, erythrocyte sedimentation rate, urinalysis and other tests which seemed indicated after the interview. Approximately 20 per cent of the patients in both groups had uncomplicated hypertension. Our criterion for hypertension was arbitrary; that is, any systolic blood pressure of 145 mm. Hg or over or any diastolic blood pressure of 95 mm. Hg or over which existed prior to the day of surgery was considered hypertension.

TABLE I. DATA ON PATIENTS

		GROUP I	GROUP II
Number of patients		45	40
Sex	Male	26	18
	Female	19	22
Race	Negro	29	22
	Caucasian	16	18
Mean weight (pounds)		151.0	168
Mean hematocrit		43.3%	45
Mean age (years)		39.5	37.9

The patients were selected from those who required full-mouth extractions and alveolectomies and who had sufficient teeth to necessitate at least four different operations. This choice of operative procedure provided a method with a more predictable amount of surgical trauma and a more standard operating time than could be realized in the performance of such random office procedures as removal of impacted teeth, routine single and multiple extractions, cystectomies, and the like.

Two separate but parallel studies, in groups of patients designated as Group I and Group II, are presented in this report (Table I). In Group I the primary objective was to study Pentothal sodium (sodium thiobarbituric

acid). In Group II the parasympatholytic drug, Banthine, was used with both Pentothal sodium and the new barbiturate, Neraval sodium (methitural sodium). Parasympatholytic drugs, such as atropine, scopolamine, and Banthine, are used by many oral surgeons for the control of salivary and pharyngeal secretions. Banthine, which is said to have a quick recovery time, was selected for our studies since it is a drug with minimal side effects and its evaluation would be simpler and more accurate. All patients in Group II were given 100 mg. of the drug orally one hour before the operation.

In both groups, nitrous oxide-oxygen (in a ratio of 70 per cent to 30 per cent), with and without premedication, was used in a small number of resistant patients who could not be managed satisfactorily without these adjuncts.

In an attempt to calibrate the trauma, we adopted a routine surgical procedure which included (1) gingival incisions and periosteal stripping of the entire area, usually a quadrant; (2) removal of bone with chisels before the teeth were extracted; (3) extractions followed by bone contouring with rongeurs and files; and (4) suturing. This exact procedure was carried out whether it was surgically indicated or not, inasmuch as no harm was done to the patient and only an additional expenditure of time was involved.

TABLE II. GENERAL OPERATIONS DATA

	GROUP I	GROUP II
Number of operations	128	120
Pentothal sodium (alone)	105	41
Pentothal sodium +	23	—
Neraval sodium (alone)	0	46
Pentothal sodium and Neraval sodium + (Group II)	—	33
Average number of teeth extracted	4.4	4.0
Average total dosage (mg.)		
Pentothal sodium (alone)	516.2	552.4
Pentothal sodium +	582.0	586.2
Neraval sodium (alone)	—	1,026.8
Neraval sodium +	—	1,233.4
Average length of operation (minutes)		
Pentothal sodium (alone)	17.1	17.1
Neraval sodium (alone)	—	15.5
Pentothal sodium +	23.2	24.0
Neraval sodium +	—	20.3
Average dose of postoperative medication		
APC tablets	2.1	2.1
Narcotics	0.0	0.0

+ = Operations in which nitrous oxide and oxygen and/or premedication (Demerol or Seconal) was necessary in the clinical management of the case.

Table II presents the general operations data in the two studies. The average total dosage and length of operation in patients given Pentothal sodium + (Groups I and II) and Neraval sodium + (Group II), compared to the average total dosage and length of operation in patients given barbiturate alone, is a reflection of the "resistant" patient. The symbol + indicates the operations in which nitrous oxide and oxygen and/or premedication (Demerol or Seconal) was necessary in the clinical management of the case.

Each patient was evaluated by means of a monitoring type of electrocardiograph and electroencephalograph.* A continuous blood pressure apparatus† was used for a part of the study, but technical difficulty with the instrument at various times during the study prevented incorporation of the data into the final results. Conventional blood pressures were taken every minute for the first five minutes and at three-minute intervals thereafter. Recordings of other vital signs were also made and a synchronized, minute-by-minute operative narrative was taken by a separate member of the technical staff (Fig. 1).

Since an important objective of the study was to correlate and interpret the effects of the anesthetic agent and the surgical trauma on the readily measurable vital functions, it was necessary to have all data delivered from the machine and tabulated by the anesthesiologist in the correct time sequence. This was done by (1) recording in proper time sequences on the operative narrative all pertinent operative details (incisions, stripping of periosteum, bone filing and manipulation, extraction of teeth, and suturing), as well as blood pressure readings at prescribed intervals, respiratory rate, obstruction of the airway, laryngospasms, and the like, and (2) correlating the narrative summary with the anesthograph record, which in effect placed all the records on one summation sheet in proper chronological order (Fig. 2).

A preoperative and postoperative observation sheet was employed in order to secure additional data.

FINDINGS AND DISCUSSION

Timing of Drug Administration.—Proper timing in the administration of Pentothal sodium and similar agents so that adequate depths of anesthesia are attained at the precise time when maximum trauma is anticipated has long been the goal of advocates of this type of anesthesia.[2-3] The dosage, administered in intervals, was recorded (Table III). The mean initial dose was about one-

TABLE III. ANESTHETIC DOSAGE BY INTERVALS FOR THE FIRST FIFTEEN MINUTES OF OPERATION

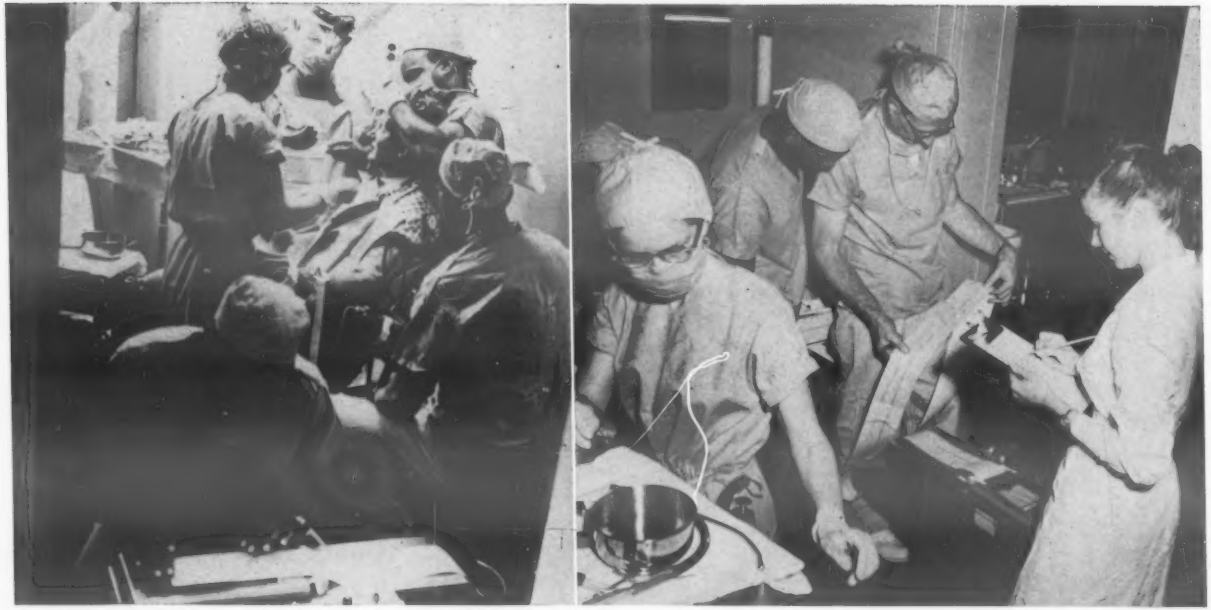
DRUG (MG.)	INITIAL	MINUTES					TOTAL* (MG.)
		1-3	4-6	7-9	10-12	13-15	
Pentothal sodium	298.3	62.4	61.5	44.2	33.0	19.1	516.2
Pentothal sodium with Banthine	276.8	104.3	83.5	47.5	18.6	19.6	552.4
Neraval sodium with Banthine	500.4	225.4	128.2	80.9	69.5	20.6	1,026.8

*Total dose for an average seventeen-minute operation exceeds by several milligrams the total for the first fifteen minutes shown.

half the total dose in a seventeen-minute operation. The increments are seen to decrease generally in successive periods until the "coast" is reached. The "coast" is the length of time that elapses between the injection of the last increment of drug and the end of the operation and demonstrates the latent

*The Edin Anesthograph (Fig. 1), Edin Company, Worcester, Massachusetts, is an electronic instrument which records continuous electrocardiograms, electroencephalograms, and accurate second-by-second pulse information.

†Sphygmotonograph, Cambridge Instrument Company, Ossining, New York.



A. *B.*

Fig. 1.—Two views of the operating room: *A*, The position of the patient in relation to the auxiliary personnel. *B*, A staff member taking the operative narrative and the anesthesiologist reading the anesthograph record.

analgesic, amnesic, or otherwise unclassified property of the intravenous barbiturates. This allows the operator between five and six minutes in an operation lasting approximately seventeen minutes, to perform gingival trimming, minor alveolar surgery, and suturing without additional injection of the drug.

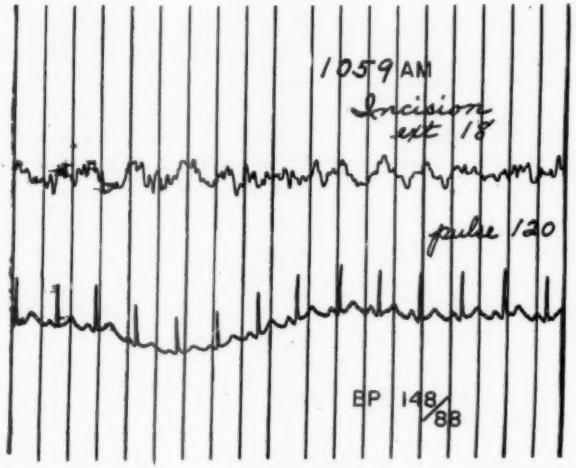


Fig. 2.—Photograph of an anesthograph record with the narrative superimposed. The electroencephalographic tracing is above and the electrocardiogram is below. Continuous heart rates were obtained by counting the number of QRS complexes appearing within a ten second period and multiplying by a factor of 6 for "rate" per minute. The vertical lines are at 0.4 second intervals.

The average values for this latent effect in our study were as follows: Pentothal sodium, Group I, 5.5 minutes; Pentothal sodium, Group II, 6.5 minutes; and Neraval sodium, Group II, 5.0 minutes. There is no such "coast" when nitrous oxide-oxygen is the principal agent.

Observations During the Preoperative and Postoperative Periods.—Some of the more useful information derived is shown in Table IV. One of the interesting but inexplicable findings was that at the conclusion of surgery, although

TABLE IV. GENERAL POSTOPERATIVE DATA

	GROUP I		GROUP II			
	PENTOTHAL SODIUM		PENTOTHAL SODIUM		NERAVAL SODIUM	
	NUMBER OF OPERATIONS	PER CENT	NUMBER OF OPERATIONS	PER CENT	NUMBER OF OPERATIONS	PER CENT
Responding to trauma	117	90.0	46	96.0	44	84.4
Opened eyes on command	109	83.9	43	89.6	28	53.8
Headaches						
Day of surgery	5	4.7	10	22.9	11	21.1
Day after surgery	3	2.8	5	10.4	3	5.5
Nausea						
Day of surgery	5	4.7	4	8.3	5	9.6
Day after surgery	3	4.3	0	0.0	2	3.8

clinically and by electroencephalographic evidence the patients were in comparable planes of anesthesia, almost 90 per cent of the patients in Groups I and II given Pentothal sodium could open their eyes on command within three minutes, whereas only a little more than 50 per cent of the Neraval sodium group could do so.

The significant increase in headaches in Group II might possibly be related to the blood pressures and pulse rate increases which will be described later. The incidence of postoperative nausea was substantially the same in both groups. Two patients in the first group and one in the second group vomited in the immediate postoperative period. This incidence is extremely low in comparison to the estimated 15 to 20 per cent in the hospital anesthesias of comparable duration.

Another finding of interest derived from the postoperative observation sheet was the low average dose of postoperative analgesic drugs (A.P.C.,* 2.1; narcotics, 0). This average dose of A.P.C. is extremely low for a seventeen-minute operation involving four extractions and an alveolectomy. Although narcotics were not dispensed routinely, the operations were performed in the morning and most of the employee-patients did not leave the Clinical Center until 5 P.M. None returned for stronger drugs, although they were told that they were available if needed.

The finding seems to substantiate the clinical impression of the majority of oral surgeons that the postoperative sequelae following general anesthesia are minimal and less than would be expected following comparable surgery under local anesthesia.

Circulatory Oxygenation.—Some investigators have shown that, as a result of the respiratory depression caused by the barbiturates, a dangerous hypoxemia and/or hypercapnia can be produced.[4] Apnea due to Pentothal sodium was interrupted by surgical stimulation approximately one minute after induction, whereas apnea due to Neraval sodium was practically nonexistent. To check the oxygen and carbon dioxide content of the blood before, during, and after operation, we selected ten patients in Group II (five given Pentothal sodium and five given Neraval sodium) for special study. Preoperative intra-arterial punctures were made on these unpremedicated, anxious patients.† The amount of psychic trauma produced by intra-arterial punctures created an unnatural research situation. Several of the patients had varying degrees of syncope as a result, and their samples were discarded on clinical grounds before processing as not being representative. Samples were taken‡ preoperatively and at the intervals indicated in Table V. In the ten cases selected at random, there was no evidence of either hypoxemia or significant hypercapnia.

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*Aspirin, 0.23 Gm.; acetophenetidin, 0.15 Gm.; and caffeine, 30 mg.

†The earpiece oximeter (oxyhemograph) will be used in future studies to get this extremely valuable information on circulatory oxygenation. The instrument is similar in appearance to the other instruments being used in the study and will be more acceptable to the patients. It measures relative rather than actual oxygen content of the blood. The patient is not subjected to a traumatic experience, and both recognizable and subtle changes in oxygenation are prevented.

‡Appreciation is expressed to Dr. R. Saunders, National Heart Institute, who obtained the arterial blood and made the analyses.

Electroencephalographic Findings.—The electroencephalograph has been used as a research tool since 1935, but only during the last ten years has this instrument been employed in clinical anesthesiology. The studies reported by Courtin and associates[5] in 1950 demonstrated the practical value of the electroencephalograph in gauging the depth of ether anesthesia. Kiersey and colleagues[6] soon applied the same tool to Pentothal sodium anesthesia and gave a similar classification of anesthetic depth by means of characteristic brain wave patterns.

TABLE V. OXYGEN SATURATION AND CARBON DIOXIDE CONTENT OF THE ARTERIAL BLOOD OF TEN PATIENTS SELECTED AT RANDOM (GROUP II)

SAMPLES	OXYGEN (PER CENT)	CARBON DIOXIDE (VOLUMES PER CENT)
Preoperative	93.0	43.7
Two minutes	91.0	40.6
Five minutes	92.0	45.3
Ten minutes	91.4	45.7
Postoperative	90.4	45.9

The electroencephalographic patterns, corresponding in general to the stages of anesthesia, were described as follows: resting, 8 to 12 cycles per second; alpha rhythm (low amplitude); first pattern characterized by high amplitude (increased voltage to about 75 microvolts) and fast, spiky waves of mixed frequencies with a predominant frequency near 20 c.p.s.; second pattern, which was a complex of many frequencies, differing mainly from the first in the preponderance of slower wave forms of irregular contour and random occurrence; some of the larger waves were as high as 150 microvolts; superimposed and at intervals were faster waves of spiky and irregular character; third and fourth patterns were characterized by a progressive decrease of both frequency and amplitude until in the fourth pattern there were three- to ten-second intervals between activity (so-called "burst activity").

In our study of Pentothal sodium in both groups, it was found that most of the work was performed between the first and second levels. The second or deeper level appeared practically always during induction (within a minute or so following the initial injection) and occasionally when incremental doses were given at frequent intervals. Rapid emergence from this level was characteristic. At the completion of surgery, during the previously described five- or six-minute "coast" in which no drug was administered, the levels were usually above the first pattern. In the early days of the study, the anesthetic team frequently remarked that the patient was awake as far as the electroencephalographic pattern was concerned.

Fig. 3 shows the two electroencephalographic levels at which we worked and the resting level, all placed on the same record for comparison. From top to bottom are shown the following levels: 0 (awake), 1, and 2. Following the first injection of barbiturate, the earliest changes are seen in eighteen to twenty-two seconds. If the estimated initial dose was correct, level 2 was reached in about one minute.

This same illustration can be used to demonstrate the "lag" phenomenon recently described by Galla and co-workers.[7] The clinical stages "lag" behind the electroencephalographic changes so that on induction, even though the patient is in level 2, he is not ready to accept surgery. On induction, the instrument indicates that the patient is in a deeper stage than he actually is. On the other hand, several minutes after induction, oral surgery is performed at level 1 or between levels 1 and 2. At the completion of the operation, the electroencephalogram always indicates lighter anesthesia than is clinically demonstrated. The machine usually shows depths between level 1 and awake.

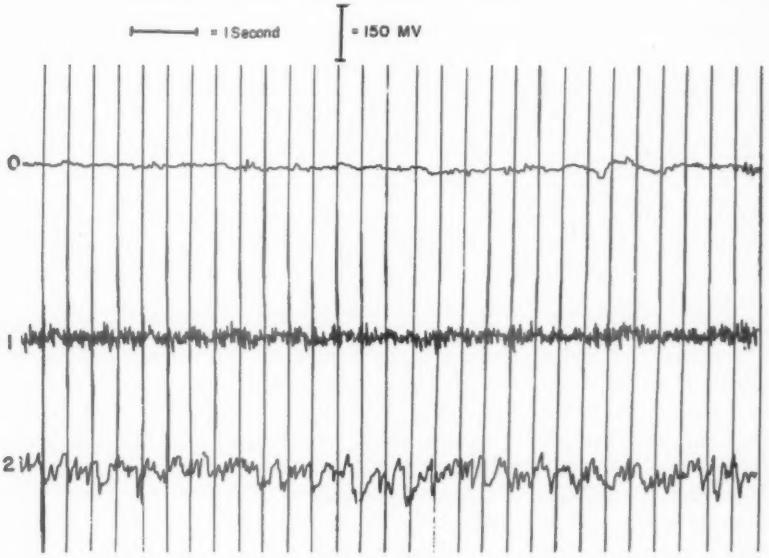


Fig. 3.—Reproduction of electroencephalographic tracings (placed on one record for convenience) obtained at different levels during Pentothal sodium anesthesia (Groups I and II). (See text.)

In our study of Neraval sodium in Group II, the typical Pentothal sodium level 1 (that is, the fast, spiky, rather regular waves) was never seen. Rather, there was a gradual transition from the resting stage to what approximated Pentothal sodium level 2, but with slightly more electrical activity, frequently approximating 200 microvolts. "Burst suppression" was never seen, and the patients were kept at levels comparable clinically to that of Pentothal sodium anesthesia. Fig. 4 shows all the electroencephalographic levels seen during Neraval sodium anesthesia, placed on a single record for comparison. The awake pattern is designated *0*; the first level is indicated by *1* and was reached in eighteen to twenty-two seconds; level 2, consistently seen a minute after injection if the dose was estimated correctly, was the deepest stage observed during any of the Neraval sodium studies. Emergence from level 2 is indicated by *X* in the illustration, and the patient is again approaching level 1.

This level (X) was the one in which most of the surgery was done. Toward the end of the operation, the pattern approximated the awake pattern and is indicated by *Y*. The only significant differences have been pointed out, namely, the absence of the fast, spiky waves of Pentothal sodium level 1 and the general display of greater electrical activity (amplitude). The "lag" phenomenon was also a constant finding with Neraval sodium.

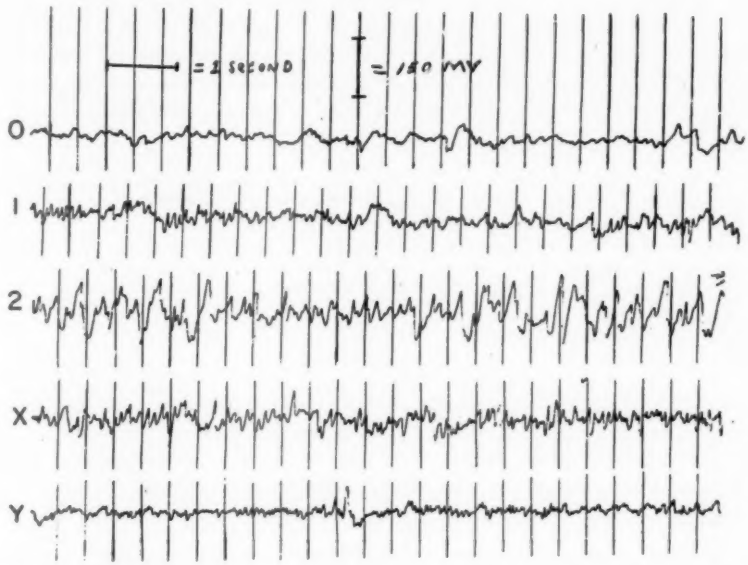


Fig. 4.—Reproduction of electroencephalographic tracings (placed on one record for convenience) obtained at different levels during Neraval sodium anesthesia (Group II). (See text.)

Electrocardiographic Changes.—The science of electrocardiography is open to subjective evaluation, and any group of cardiologists might differ in their interpretations of multi-lead recordings taken under ideal conditions. Since, in our study, only the rate, rhythm, and arrhythmias were to be evaluated, lead II was selected as adequate. As a control procedure for comparative readings, preoperative and postoperative tracings were obtained. We did not anticipate or find any electrocardiographic changes due to organic heart disease in our patients. The changes expected and found were those related to the anesthetic agent itself or to sympathetic bombardment following intense surgical stimulation in the presence of a poor analgesic agent. As shown by Wilde,[8] fear, anxiety, emotion, and other of life's vicissitudes produce functional abnormalities in susceptible nonanesthetized persons.

It has been reported by many investigators that atropine and other parasympatholytic drugs tend to reverse the above changes.[9] In order to check these

findings, we used Banthine in all patients in Group II. Since an unpremedicated base line had already been established in Group I, we were now ready to evaluate the effects of premedication with a vagolytic agent.

Because of technical inadequacies, no attempt was made to study the electrocardiographic records minutely. However, among the arrhythmias noted were premature ventricular contractions occurring once or only occasionally, premature ventricular contractions occurring frequently, bigeminal and trigeminal premature ventricular contractions, and infrequent sinus arrhythmias.

There was a considerable reduction in the over-all electrocardiographic changes in Group II. The intensity, frequency, and duration of the arrhythmias as well as the number of patients affected and the number of operations in which arrhythmias occurred were reduced. These changes are shown graphically in Table VI.

TABLE VI. ELECTROCARDIOGRAPHIC CHANGES (ARRHYTHMIAS ONLY) IN ANESTHETIZED PATIENTS (GROUP II) WITH AND (GROUP I) WITHOUT A PARASYMPATHOLYTIC ADJUNCT (BANTHINE)

	GROUP I	GROUP II
Patients studied	37	27
Patients affected	15 (40.5%)	7 (25.5%)
Operations	109	117
Operations in which arrhythmias were demonstrated	20 (18.3%)	11 (9.4%)

These changes denote disturbances in the electrical conduction system of the heart, and more study of these phenomena is planned. This is felt to be especially important since the changes are found not only during anesthesia but often in normal hearts of unanesthetized subjects and their real significance is not clear.

Pulse Findings.—The pulse rate and blood pressure have long been recognized as the most reliable and valuable signs in proper anesthetic management,[10] and they were chosen for more detailed study.

Krogh and others have reported preoperative and operative tachycardia in a large number of their unpremedicated patients.[2-3] Tachycardia was defined in our study as a rate of 120 or greater per minute. The preoperative tachycardias on the day of surgery were as follows: Group I, eleven patients (24.4 per cent) during fifteen operations (11.7 per cent); Group II, seventeen patients (42.5 per cent) during thirty-seven operations (30.8 per cent). The effects of fear and anxiety on the heart rate are clearly seen in Fig. 5 when the rates on the day prior to surgery are compared with the immediate preoperative rates. In Group I the differential was 16 beats per minute, while in Group II it was 22 with Neraval sodium and 28 with Pentothal sodium. The greater difference in Group II was felt to be due to the vagolytic action of Banthine.

The rates during surgery were seen to be consistently greater in Group II than in Group I, again implicating the vagolytic action of Banthine (Fig. 5).

To demonstrate further the differences between the drugs within the groups as far as effect on pulse is concerned, the preoperative heart rate with each drug

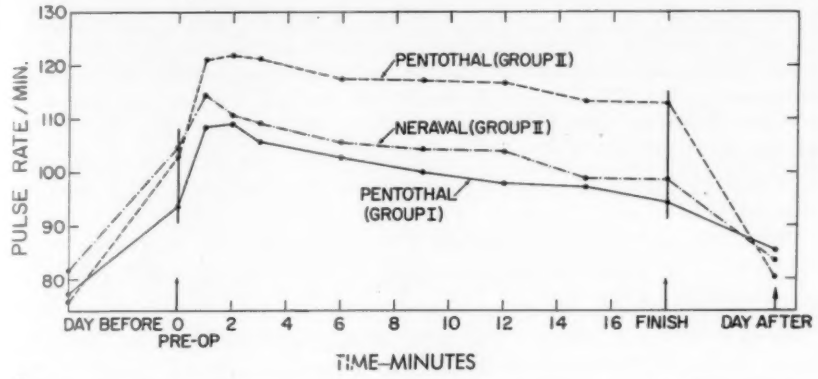


Fig. 5.

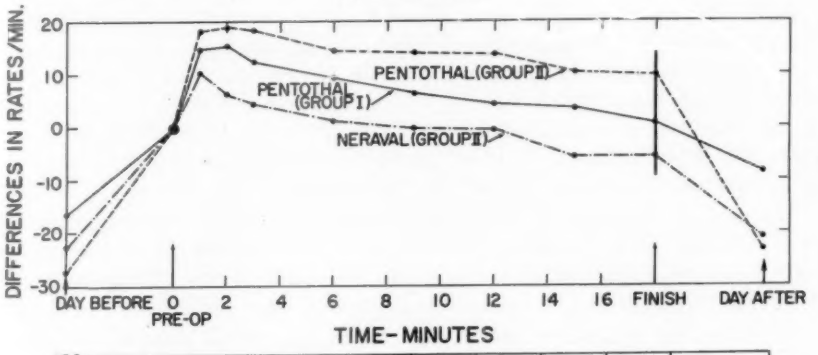


Fig. 6.

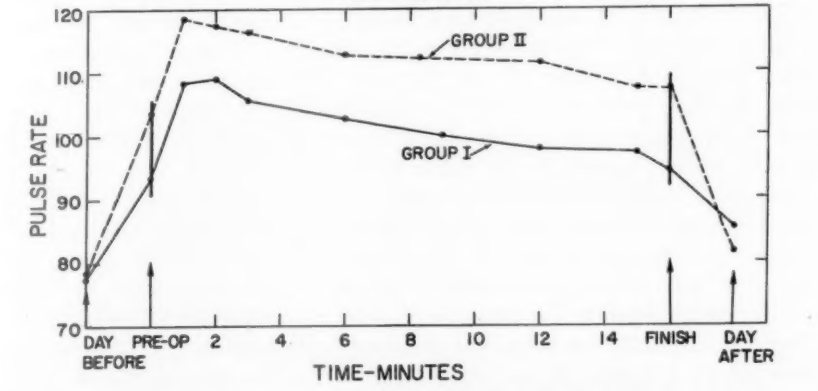


Fig. 7.

Fig. 5.—Comparisons of pulse rates in persons who received Pentothal sodium (Groups I and II) or Neraval sodium (Group II) for a minimum of fifteen minutes. The pulse rate taken on the day before the operation was considerably less than the immediate preoperative rate, and a significant difference was also seen between the rates at the conclusion of surgery and on the day after surgery. All Group II patients received 100 mg. of Banthine.

Fig. 6.—Chart showing the same data as Fig. 5, with the starting point of each drug plotted at zero. The preoperative rate was then subtracted from the rates taken at specified time intervals, and the relative difference between each drug is more graphically illustrated.

Fig. 7.—In this chart the pulse rates of the patients in Group II who received Pentothal sodium and Neraval sodium were considered as a unit and compared with the pulse rates in Group I.

was placed at zero and the difference between this point and all other points in Fig. 5 was plotted. These differences are shown in Fig. 6. The pulse rate was significantly accelerated when Banthine was used as an adjunct to Pentothal sodium anesthesia. The rates were lower with Neraval sodium and Banthine than with Pentothal sodium with and without the premedicant. The pulse rates reached maximum values in one minute after the injection of Neraval sodium and in two minutes after the injection of Pentothal sodium in both Groups I and II.

When both barbiturates (Group II, Pentothal sodium and Neraval sodium) were considered as a unit and plotted against Group I, the vagolytic acceleration was more striking (Fig. 7).

Blood Pressure Findings.—The most unusual, and possibly the most significant, finding in this study relates to elevation of the blood pressure. Although blood pressure and pulse in general reflect similar physiologic mechanisms, there was one demonstrable difference in our studies. In both groups the pulse rate reached a maximum value in one to two minutes while the blood pressure lagged, reaching its maximum in six minutes. The pulse seemed to be a sensitive indicator of the drug used, and the effects were rapid and consistent. On the other hand, the blood pressure response appeared to be related more to surgical stimulation than to the drugs per se.

The medical literature is replete with accounts of drops in blood pressure during Pentothal sodium anesthesia. As early as 1936, one such classical report by Allen and associates[11] of the Mayo Clinic demonstrated this. Their patients had essential hypertension, were not premedicated, and were being evaluated as candidates for sympathectomy under Pentothal sodium anesthesia. The primary difference in the experimental condition of that study and our own was that no stimulation was given in the former whereas an oral surgical stimulation was provided in ours. Another point of difference to be considered was the fact that one single large dose was administered to patients in the supine position in the study by Allen and associates whereas smaller incremental doses were given to our patients in the sitting position.

The three characteristic blood pressure curves observed in approximately 80 per cent of all patients receiving barbiturate anesthesia in both groups were: (1) a direct rise without a fall, (2) a slight fall of 10 to 20 mm. Hg during the first one or two minutes, followed by a rise, and (3) a combination of these two with undulations in the pressure directly associated with surgical procedures (Fig. 8). The systolic pressure on the chart shown in Fig. 8 (an actual photograph of a record) is seen to rise and fall in two distinct phases. The extraction of the upper and lower anterior teeth for immediate dentures in this patient was seen graphically as two distinct elevations of the blood pressure corresponding to these separate operations, that is, first surgery and insertion of the upper denture followed by the same procedure on the mandible. In the presence of a cumulative effect of the barbiturate, there was also demonstrated the ability of the human organism to respond autonomically via the sympathetic

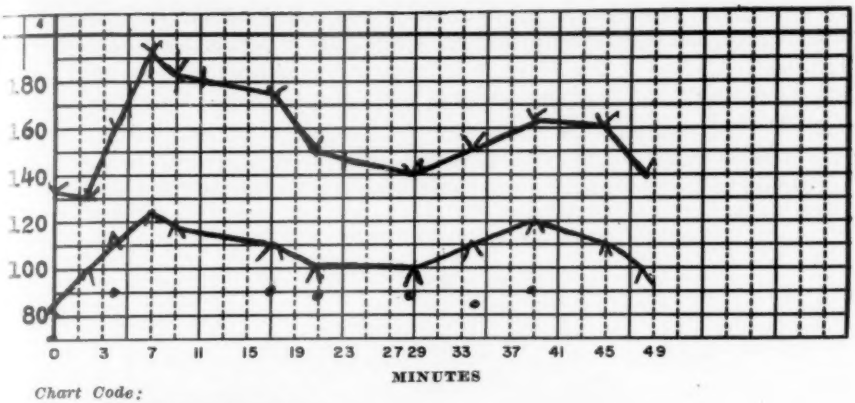


Chart Code:

∨ = Systolic pressure in mm.
∧ = Diastolic pressure in mm.

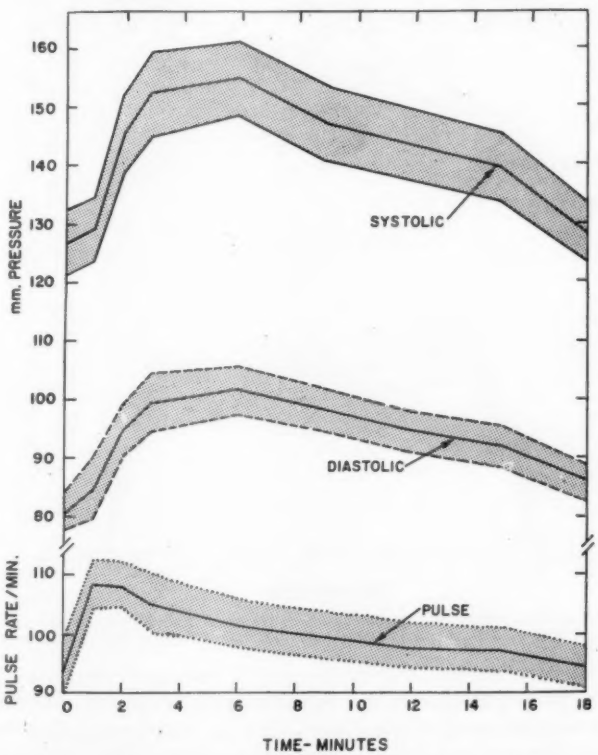


Fig. 8.—Photograph of a representative anesthesiology record of the systolic and diastolic blood pressures obtained during barbiturate anesthesia. The two separate peaks coincided with periods of maximum stimulation occurring during surgery. (See text.)

Fig. 9.—Mean blood pressures, pulse rates, and two standard errors (95 per cent confidence limits) of persons who received Pentothal sodium anesthesia for a minimum of fifteen minutes (Group I).

nervous system to a greater degree from an initial surgical insult (that is, the first twenty minutes) than to a later comparable stimulus (the last twenty minutes).

In Group I, in which Pentothal sodium alone was used, the systolic and diastolic blood pressures were seen to rise in the proportion indicated in Fig. 9. The pulse is shown in the same chart for comparative purposes. Similar data for Group II are presented for Pentothal sodium (Fig. 10) and Neraval sodium

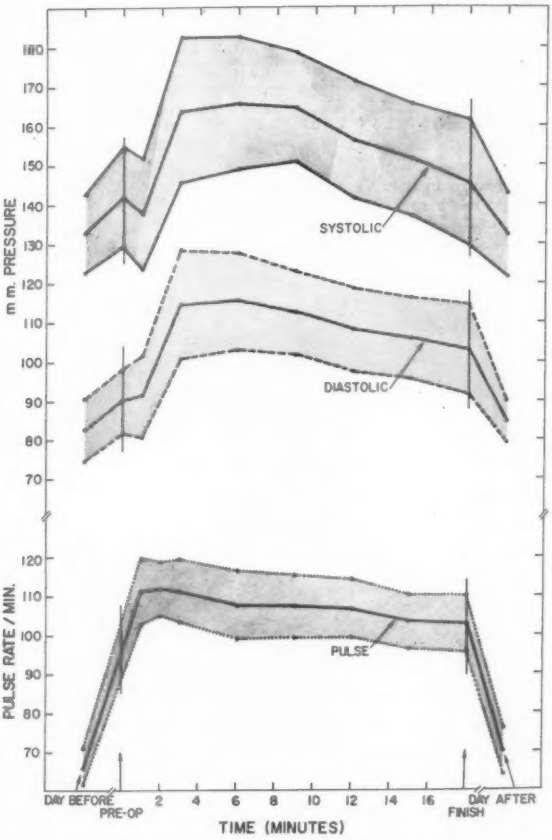


Fig. 10.—Mean blood pressures, pulse rates, and two standard errors (95 per cent confidence limits) of persons who received Pentothal sodium and Banthine for a minimum of fifteen minutes (Group II).

(Fig. 11). The blood pressure curves were essentially the same in Group I and Group II, as demonstrated by these charts, with the single exception that in the Group II cases (Pentothal sodium and Neraval sodium, Figs. 10 and 11), the pressure fell briefly during the first minute, whereas in the group receiving Pentothal sodium alone (Fig. 9) the rise was immediate and was sustained until

the peak was reached. The accelerated pulse rates and blood pressures (differences in day before and preoperative findings presumably caused by anxiety and fear) are also clearly demonstrated in Figs. 10 and 11.

A comparison of the systolic blood pressure curves of the patients in Pentothal sodium Group I, Pentothal sodium Group II, and Neraval sodium Group II is shown in Fig 12. In Pentothal sodium anesthesia the blood pressure was elevated to a greater degree than in Neraval sodium anesthesia, whether a parasympatholytic drug was used or not. The differences are more graphically illustrated when the starting points are corrected to zero (Fig. 13).

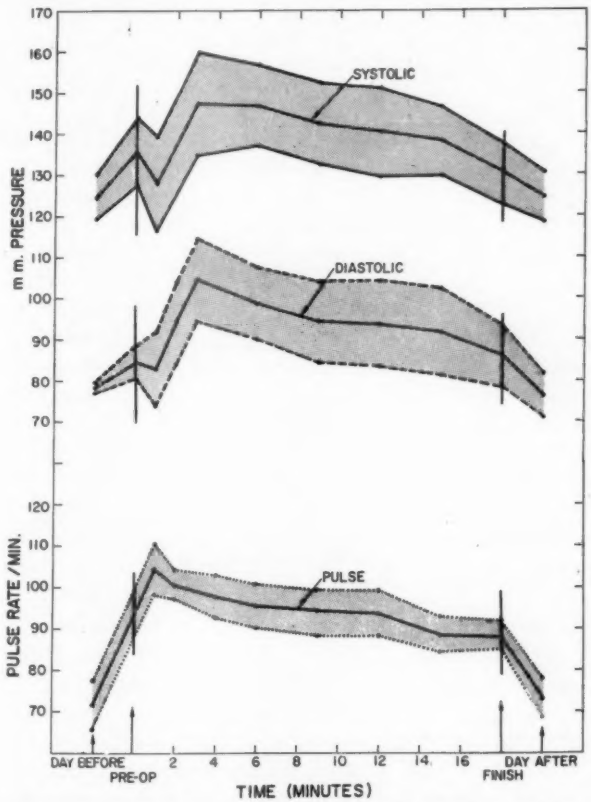


Fig. 11.—Same data as in Fig. 10 on patients who received Neraval sodium anesthesia for a minimum of fifteen minutes (Group II).

Premedication and adjunctive agents, such as nitrous oxide-oxygen, are used routinely by many oral surgeons, but their use is accompanied by an increased incidence of postoperative sequelae, such as dizziness, nausea, vomiting, and delayed recovery. Nevertheless, these agents are indicated when pulse and blood pressure control are deemed necessary. Fig. 14 illustrates the effect of the addition of a premedication, P+ (Demerol), or nitrous oxide-oxygen (Pn), both

Fig. 12.

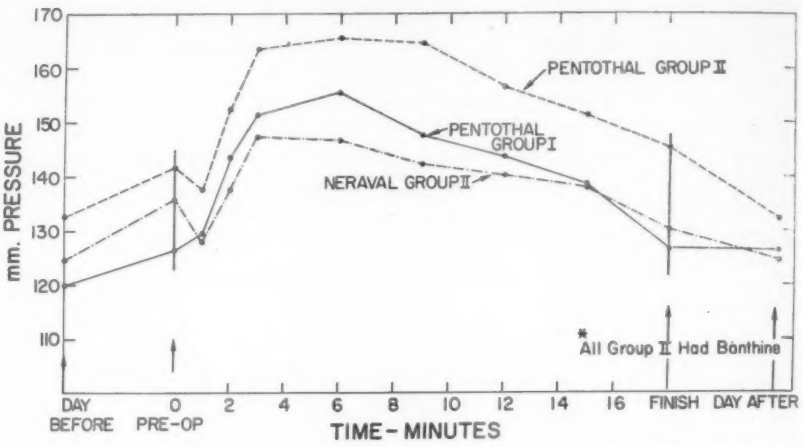


Fig. 13.

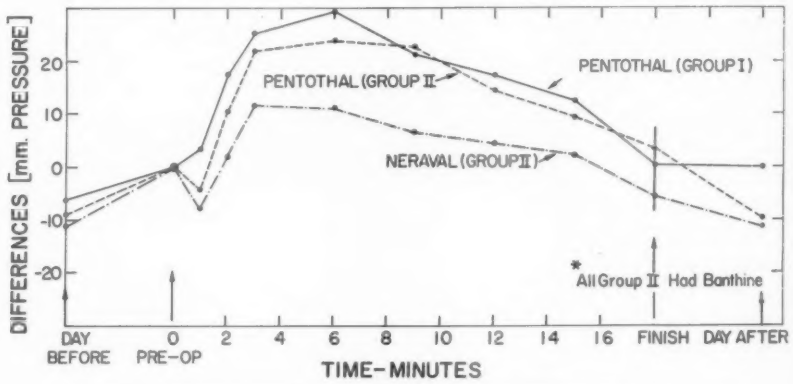
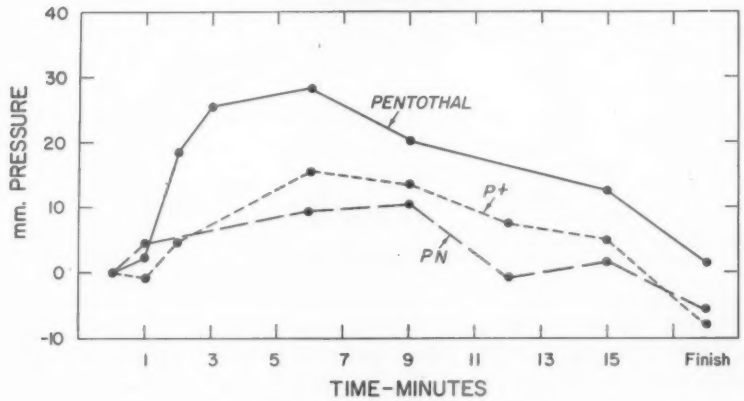


Fig. 14.



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of which attenuate the blood pressure rise. As a rule, these adjuncts mitigate against a rise in the blood pressure and, to a lesser extent, an increase in the pulse rate. It must be recalled that the patients plotted on Fig. 14 were premedicated or given nitrous oxide only when they could not be satisfactorily managed without these agents. These were "resistant" patients and, as suggested, the pulse rate and blood pressure of normal patients can be more easily controlled.

The data demonstrating operative hypertension and tachycardia should be of material value to those using either Pentothal sodium or Neraval sodium alone as their anesthetic agent. Patients particularly suitable for adjunctive techniques are those in whom a marked blood pressure rise is contraindicated (for example, patients with hypertensive cardiovascular disease, a recent history of a cardiovascular accident, and those with known or suspected cardiac insufficiency).

SUMMARY

1. Physiologic data on patients under the stress of general anesthesia and dental surgery while being operated on in the sitting position have been presented.

2. Base lines of response in terms of physiologic performance on the intravenous barbiturates, Pentothal sodium and Neraval sodium and the parasympatholytic drug, Banthine, have been presented.

3. The average initial doses of the anesthetics were as follows: Pentothal sodium, 276 mg.; Pentothal sodium (with Banthine), 298 mg.; Neraval sodium (with Banthine), 500 mg. The initial dose was observed to be slightly greater than one-half of the total dose given for an operation of approximately seventeen minutes' duration.

4. Continuous electroencephalographic and electrocardiographic monitoring was performed on all patients and revealed changes consistent with those that have been described previously in the literature.

5. In the presence of a vagolytic agent, Banthine, there was an increased pulse rate. However, there was a significantly reduced incidence of arrhythmias.

6. The blood pressure and pulse rates rose rapidly and significantly. Pulse rates reached maximum values in one to two minutes, and the blood pressures reached their peak in six minutes. These findings varied with the anesthetic agents utilized but were consistent within each drug studied.

7. In ten randomly selected patients whose arterial blood was analyzed, there was no evidence of either hypoxemia or significant hypercapnia.

Fig. 12.—Comparison of systolic blood pressures of persons who received Pentothal sodium (Groups I and II) and Neraval sodium (Group II) for a minimum of fifteen minutes. Day-before and day-after differences are also shown.

Fig. 13.—The same data from the preceding figure are shown with the starting points plotted at zero, and the relative differences in response of the different drugs is demonstrated. (See Fig. 6 for method of computation.)

Fig. 14.—Differences between the preoperative and operative systolic blood pressures in patients who received Pentothal sodium, Pentothal sodium and Demerol (P^+), and Pentothal sodium and nitrous oxide-oxygen (P^N). Relative differences are plotted from zero as in Figs. 6 and 13.

8. The long-accepted fact of significant hypotension following barbiturate anesthesia was not confirmed in our investigations. Rather, a significant elevation of the blood pressure occurred while the patients were undergoing a standardized oral surgical procedure. This suggests the need for a re-evaluation of hypotension and hypertension as related to anesthetic choice and management.

Appreciation is expressed to Dr. C. L. Hebert, Chief of the Anesthesiology Department, Clinical Center, National Institutes of Health, for his encouragement and assistance in this study.

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EDITORIAL

PROFESSOR ALFRED GYSI

At the Congress of the Fédération Dentaire Internationale last September, the president of the Swiss Odontologie Society presented the Powlett Memorial Lecture in memory of Professor Gysi. This presentation denotes international acclaim of one of the great scholars of dentistry.

The Swiss journal *Helvetica Odontologica* (Vol. 3, Nov. 2, 1959) has joined this international ovation to a Swiss pioneer by devoting an entire issue to papers contributed by members of the Zürich University Dental Institute who, under Professor Gysi's direction, worked in the laboratories of the old buildings which are to be replaced next fall by a new and modern edifice. The following scientists have made contributions in that issue, dedicating their articles to the inspiring memory of Professor Gysi: Hans R. Mühlemann and Ulrich K. Schneider, Department of Operative Dentistry and Periodontology, "Early Calculus Formation"; Thomas M. Marthaler, Experimental Caries Research Laboratory, "Enamel Penetration by Thiourea-S^{35} After Fluoride Treatments"; H. R. Mühlemann, M. Ebneter, and W. Rupf, Department of Operative Dentistry and Periodontology, "Diurnal Variations in Mitotic Activity of Oral and Corneal Epithelium in Colchicinized Albino Rats"; H. R. Mühlemann and Fred Wolgensinger, Department of Caries Research, "In Vivo Reduction of Enamel Solubility in Children Using an Organic Fluoride Dentifrice"; Klaus G. König, Caries Research Laboratory, "Dental Caries and Plaque Accumulation in Rats Treated With Stannous Fluoride and Penicillin"; and K. G. König and H. R. Mühlemann, Department of Operative Dentistry and Periodontology, "Alterations in Rat Gingivae Due to Plaque Accumulations."

We congratulate the staff at the Zürich University Dental School on the worthy and magnificent Festschrift.

K. H. T.

ANNOUNCEMENTS

American Society of Oral Surgeons

The forty-second annual meeting of the American Society of Oral Surgeons will be held Oct. 12 to 15, 1960, in Phoenix, Arizona. Headquarters hotel will be the Westward Ho.

Following the forty-first annual meeting held in October, 1959, in New York City (with an attendance of approximately 1,000), membership in the Society is 947.

The following officers have been elected to serve in 1959-60 (through the Phoenix meeting): *President, Fred A. Henny,* Henry Ford Hospital, Detroit, Michigan; *President-Elect,* Frank H. O'Halloran, Evansville, Indiana; *Vice-President,* Lyall O. Bishop, Walnut Creek, California; *Secretary-Treasurer,* Edward C. Thompson, Urbana, Illinois.

New York Institute of Clinical Oral Pathology, Inc.

The following monthly conference dates have been announced:

Dec. 21, 1959	March 28, 1960
Jan. 25, 1960	April 25, 1960
Feb. 29, 1960	May 23, 1960

American Academy of Dental Medicine

The spotlight of scientific study will focus on "The Seven Ages of Man" at the fourteenth annual meeting of the American Academy of Dental Medicine, according to Co-chairman Jacoby T. Rothner and Bernard B. Saturen. The meeting will be held May 27 to 30, 1960, at the Warwick Hotel in Philadelphia.

Oral Pathology Laboratory of Mount Sinai Hospital

The Oral Pathology Laboratory of Mount Sinai Hospital in New York City will hold its second Clinical Oral Pathology Conference at 5 P.M. on Friday, Jan. 13, 1960. The topic will be "Paget's Disease and Fibrous Dysplasia of the Jaws," and Dr. Lester R. Cahn will be the speaker. The conference will be held in Lecture Room 3-B on the third floor of the Administration Building, Mount Sinai Hospital.

Department of Health, Education, and Welfare

A competitive examination for appointment of dentists as officers in the Regular Corps of the United States Public Health Service Commissioned Corps will be held throughout the United States on March 1, 2, 3, and 4, 1960.

Entrance examinations will include an interview, a physical examination, written objective examinations in the professional field, and a practical examination in various

phases of dentistry. The written objective examination will include the following subjects: bacteriology, general anatomy, pathology, physiology, oral surgery, oral medicine, oral pathology and bacteriology, pharmacology, operative dentistry, prosthetic dentistry, dental materials, periodontia, roentgenology, pedodontia, and dental public health. The practical examination will require completion of an amalgam restoration and a gold inlay. It may also include other demonstrations of clinical proficiency.

Application forms may be obtained from the Surgeon General, United States Public Health Service (P), Washington 25, D. C. *Applications received after Jan. 22, 1960, will not be accepted for this examination* but may receive consideration for an appointment to the Reserve Corps if the applicants wish.

Boston University School of Medicine

The Oral Surgery Section, Department of Stomatology, Division of Graduate Studies of Medicine, announces that applications for the year 1960-61 in oral surgery should be made as soon as possible. The course begins Sept. 15, 1960.

This course consists of lectures and clinical experience in the fundamental medical sciences and a basic review of all phases of oral surgery. Students will also be assigned, in rotation, to the various clinics and the Oral Surgery Out-Patient Department of the Massachusetts Memorial Hospital, and they will assist at oral surgery operations at the Brooks Hospital.

The course has been planned to meet the requirements of the American Board of Oral Surgery, providing a foundation for the clinical internship and residency training leading to qualifications for the practice of oral surgery as a specialty.

The course is under the direction of Dr. Kurt H. Thoma, Professor of Oral Surgery, assisted by a large staff of lecturers and instructors.

Those interested should apply to the Department of Stomatology, School of Medicine, Office of the Dean, Boston University, 80 East Concord St., Boston 18, Massachusetts.

University of Minnesota
Fellowship in Clinical Oral Pathology

A fellowship in clinical oral pathology for the year July, 1960, to July, 1961, is being offered at the University of Minnesota School of Dentistry by the American Cancer Society. Open to qualified dentists or dental students, the fellowship provides $3,600.00 per year, tax-free, and is renewable on approval of the American Cancer Society.

Applicants must send a curriculum vitae and academic record to Dr. Robert J. Gorlin, Chairman of Oral Pathology, University of Minnesota School of Dentistry, Minneapolis 14, Minnesota, before Feb. 15, 1960.

University of Pennsylvania

The School of Dentistry announces the following postgraduate courses:

Oral Diagnosis and Roentgenology. Jan. 4 to 8, 1960. Lester W. Burket and Leroy M. Ennis.

Prosthetic Relations of the Temporomandibular Joint. Jan. 18 to 22, 1960. Ernest R. Granger.

Hospital Dentistry. Jan. 25 to 27, 1960. John P. Looby and associates.

Endodontics Continuation Course. One day per week for six weeks beginning Jan. 6, 1960. Samuel Seltzer and I. B. Bender.

Periodontal Prosthesis. Feb. 8 to 12, 1960. Morton Amsterdam and D. Walter Cohen.

Partial Dentures. Feb. 29 to March 4, 1960. M. M. DeVan.

Practice Administration. March 7 and 8, 1960. Harry M. Klenda.

Practical and Simplified Procedures in Crown and Bridge Prosthesis. March 14 to 18, 1960. Charles B. Sceia.

Further information may be obtained by writing Dr. Lester W. Burket, University of Pennsylvania School of Dentistry, 4001 Spruce St., Philadelphia 4, Pennsylvania.

University of Pennsylvania
Clinical Fellowship in Oral Pathology

Applications are requested for a clinical fellowship in oral pathology supported by the American Cancer Society, tenable at the Department of Pathology, School of Dentistry, University of Pennsylvania, for a period of one year beginning July 1, 1960.

A stipend of $3,600.00 (tax-free) accompanies the fellowship.

Each candidate should submit a curriculum vitae and letters of reference. Replies should be addressed to Dr. C. E. Wilde, Jr., School of Dentistry, University of Pennsylvania, 4001 Spruce St., Philadelphia 4, Pennsylvania.

University of Pittsburgh

Applications are now being accepted by the Graduate Division of the University of Pittsburgh School of Dentistry for graduate study in the fields of anesthesiology, oral surgery, orthodontics, and prosthodontics, leading to the master of science degree. Selection of students for the fall session of 1960 will be made in April, 1960.

A nondegree, full-time, twelve-month course in general anesthesia is also available for qualified dental graduates.

For further information and application forms, write to Director of Graduate Education, University of Pittsburgh, School of Dentistry, Pittsburgh 13, Pennsylvania.

Tufts University

The School of Dental Medicine announces the following postgraduate refresher courses:

DPG. 606. Advanced Surgical Periodontal Treatment Technics. April 4 to 6, 1960, 9 to 5 P.M. Irving Glickman, John Prichard, Richard Taylor, Arthur Gold, and Benjamin Patur. Tuition, $125.00. (Enrollment limited to persons who have taken a previous postgraduate refresher course in periodontology.)

DPG. 902. Hypnosis and Its Clinical Applications. March 17 to 23, 1960. Lawrence Staples, Milton Erickson (Phoenix, Arizona), and staff. Tuition, $150.00.

For further information and application, write to Director, Division of Graduate and Postgraduate Studies, Tufts University School of Dental Medicine, 136 Harrison Ave., Boston, Massachusetts.

REVIEWS OF THE LITERATURE

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ABSTRACTS OF CURRENT LITERATURE

The Diabetic Dental Patient. A. Sindoni, Jr.: D. Clin. North America, pp. 459-469, July, 1958.

The careful taking of the patient's personal and family history as it relates to diabetes should be incorporated in all dental offices as a routine procedure. The evaluation of the oral cavity cannot be properly conducted without taking into consideration the general physical condition of the patient.

If a patient has a family history of diabetes or presents symptoms or signs of diabetes, and if he is not under a physician's care, one of the more recent simple laboratory urine tests for sugar should be made or the patient should be referred to a physician for discussion of the dentist's findings. It is also the duty of the dentist to know whether the patient with diabetes is adequately following his physician's instructions.

Oral surgical procedures are generally performed in the morning, two to three hours after breakfast and insulin, and local infiltration or block anesthesia, such as procaine hydrochloride or lidocaine, is used. Substances or agents containing epinephrine or Cobefrin are inadvisable because of the possibility of precipitating anginal symptoms or local adverse tissue changes.

If the condition of the oral cavity is such that the use of local anesthesia may help spread infection, it is advisable to consult the family physician regarding the type and use of general anesthesia. The general anesthetic generally employed for a short operation is nitrous oxide-oxygen. After the type of general anesthetic is decided upon, it is advisable to administer it to the patient in a fasting state, either before breakfast or four hours after breakfast.

When the patient regains consciousness immediately following the use of the general anesthetic, no food or fluid is given orally for one to two hours. After this interval, the patient is given ginger ale or strained orange juice, followed by the regular dose of insulin until the next meal, when a liquid or soft diet is given according to the diabetic formula.

Antibiotic therapy is recommended.

T. J. C.

A Study in the Treatment of 637 Patients With Trigeminal Neuralgia. D. Ruge, R. Brochner, and L. Davis: J. Neurosurg. 15: 528, September, 1958.

A series of 637 patients suffering from trigeminal neuralgia have been observed and treated over a period of thirty-eight years.

The right face was the site of pain 393 times, as compared to 228 for the left side. Sixteen patients had bilateral pain.

The average age of onset for the group was 51 years.

The maxillary division of the trigeminal nerve was affected in fifty-two cases, and the mandibular division was affected in fifty. Both the maxillary and mandibular divisions were affected in 178 cases.

Surgery (the extradural, preganglionic neurotomy) is the treatment of choice.

T. J. C.

New Concepts in Immediate Denture Service. J. W. Hughes: D. Radiog. & Photog. **32:** 20, 1959.

Three appointments are required to present and render immediate denture service.

The first appointment is devoted to taking a history, clinical examination, making of x-rays, taking of impressions, and other necessary services including photographic records.

The second appointment affords an opportunity to discuss the procedure of extraction, the appearance of the finished denture, and the fee to be charged.

At the third appointment, to which the patient is accompanied by a member of the family, the teeth are removed and the dentures are inserted.

The illustrations are excellent.

T. J. C.

Experiences in the Surgical Management of Tic Douloureux. E. S. Gurdjian, J. E. Webster, and D. W. Lendner: Surgery **45:** 264, February, 1959.

This study deals with twenty-five years' experience in the surgical management of tic douloureux. The majority of patients were over 50 years old, and the ratio of males to females was 6:7.

The diagnosis of this disease is made on the basis of sudden, sharp, shooting pains involving the second and third divisions of the trigeminal distribution on the face, associated in some cases with trigger zones on the face or in the mouth.

Patients experiencing the first attack are usually treated conservatively; some get relief for months or years.

Patients who have had repeated attacks of pain with the usual trigger zones and whose condition grows worse with time are candidates for surgical management.

The surgical treatment for tic douloureux has been fairly well standardized.

T. J. C.

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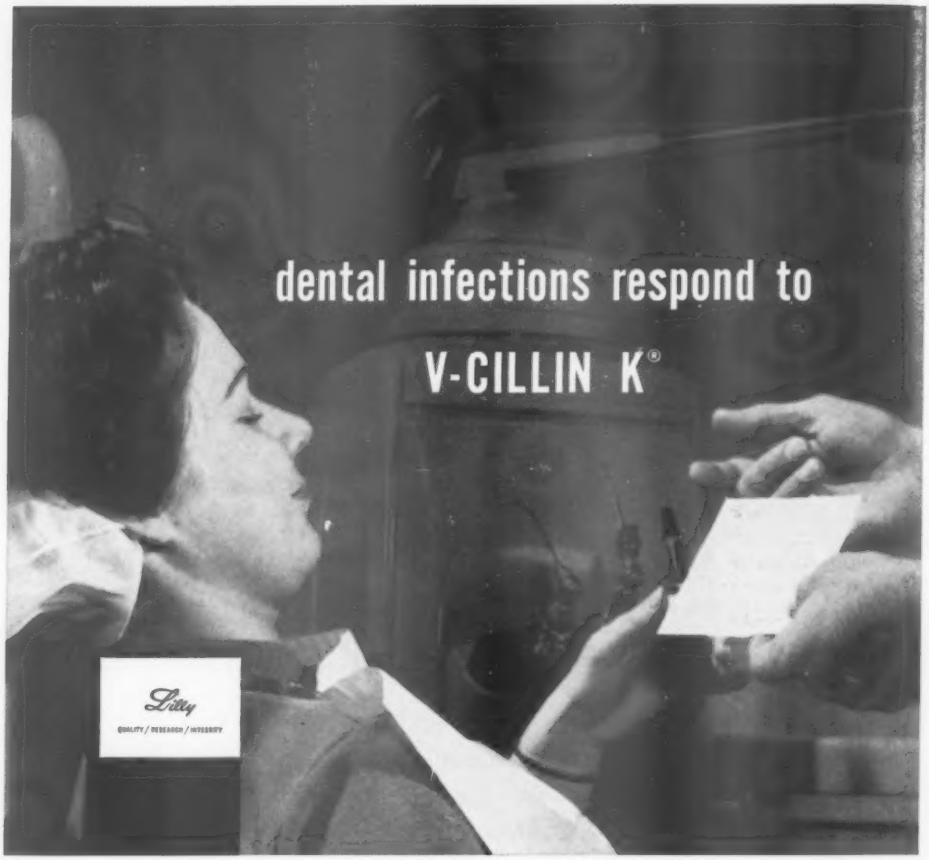

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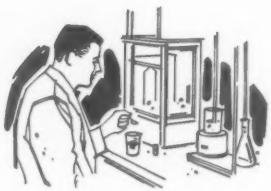

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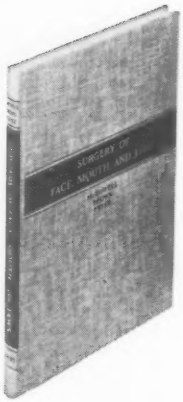

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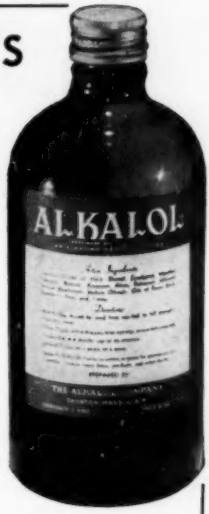

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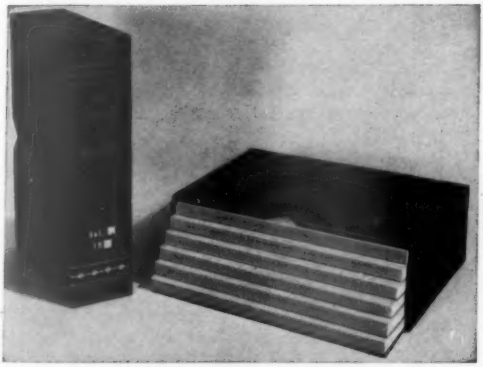

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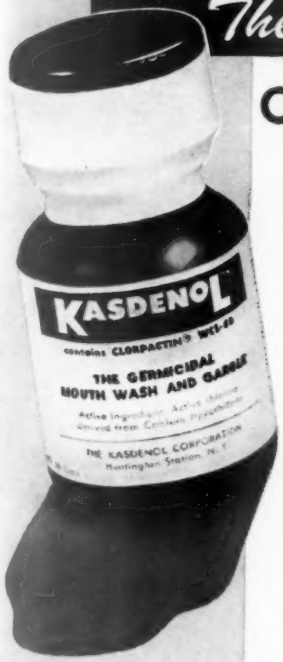

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A.M.A. Archives of Otolaryngology
Oral Surgery, Oral Medicine & Oral Pathology
New York State Medical Journal
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